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Strength and Work of the Jovians

With a membership of 12,000 individuals, the Jovian Order, the eleventh annual convention of which was held in New York during the present week, has become one of the largest and most widely representative organizations of men connected with the electrical industry in the country. During the first seven years of its existence the enrollment totaled 220, the average increase being only thirty-two per year; during the past eight years the annual increase has ranged from about 360 to nearly ten times that number. To any question concerning the need for such a society as that of the Jovian Order the enormous membership enrollment is an effective and satisfactory answer. Without some real reason for existence the Order could never have obtained a membership of 12,000. Its growth is to be credited to the spirit of fraternity and co-operation which is the foundation stone of the organization. Little difficulty is encountered in selecting several lines of activity which the Jovian Order, with its strength in numbers and diversity in membership, is well qualified to undertake. The best of these were covered in the report of Secretary Bennett, which was received with much favor and adopted by the membership. The Order has acted wisely in laying plans for serious work in the future, and even more wisely in retaining all those fraternal, co-operative features to which its present strength are to be attributed.

Anniversary of the Incandescent Lamp

Oct. 21 will mark the thirty-fourth anniversary of the incandescent lamp, for it was in 1879 that Edison made his famous horseshoe filament of carbonized thread and afterwards paper that created such intense excitement in the United States and in Europe. The problem of a practical small incandescent lamp was then completely solved, and it is a striking tribute to the genius of Edison to note that despite all the years that have since elapsed his lamp still stands without a single salient feature eliminated or added. Carbonized-paper filaments soon gave way to filaments made from bamboo and subsequently to the present squirted carbon filament; but, nevertheless, developments in the carbon incandescent lamp field were rather slow viewed in the light of those that have taken place recently. Better lamps than the carbon-filament have come and gone within the past five years, the tungsten lamp representing the survival of the fittest, and here again it is worthy to note that Edison himself first worked on metal-filament lamps using platinum, iridium, titanium and other metals only to discard them in favor of carbon. The wonderful developments in the incandescent-lamp field, especially in the high-candle-power tungsten lamps with nitrogen-filled bulbs, have come within the present year, the very latest work in this field being chronicled elsewhere in this issue. How greatly the industry is indebted to Edison for the incandescent lamp it were vain to guess. Certainly the human race owes him a debt which it can never pay.

Rapid Computation of Suspensions

In a recent series of articles published in *La Lumière Électrique*, M. André Blondel reviews some interesting graphic charts for determining the proper tension in erecting conducting spans, which he published in 1902. He now introduces some improvements in detail, which facilitate their use, and increase their precision. The improved charts appear to offer distinct advantages over their earlier prototypes. This field of overhead line construction naturally pertains to what is ordinarily called civil engineering. But in erecting the high-tension lines of most recent development, the electrical engineers have carried their experiments, computations and graphics more thoroughly into this domain of statics, field-work, and construction, than had previously been either customary or demanded. In order to ensure the maintenance of his conducting lines, under all conditions of weather, a safety factor has to be provided for any reasonable concurrence of sleet and wind. In our own columns have been recorded a variety of such investigations within the past few years.

The Triumph of Wireless

In the latest sad disaster of the sea, radio-communication once again displayed a wonderful and humane rôle. At 8 o'clock on that fateful Thursday morning on the North Atlantic, fire was discovered raging in the hold of the Uranium Line steamship *Volturno* with 650 souls aboard. Despite the utter isolation of mid-ocean about 500 passengers and crew were taken off the burning vessel, of which number every individual life must be credited to the faultless operation of the wireless and to the courage and devotion of the operators who sent and detected the signals. And not only did wireless spread the alarm, but even after the life-saving fleet had assembled in impotent cordon about the *Volturno*—the rescue ships almost as helpless in the wild seas as the victim herself—it was once more radio-communication between the plunging vessels which exchanged advice, unified effort, and facilitated work with the life-boats. And again, days before any of the rescue ships had sighted land, the newspapers of the world had spread before their readers detailed aerogram reports of the mid-ocean disaster. What a triumph, indeed, for the feeble laboratory spark phenomenon of Hertz!

Tungsten Lamps of High Efficiency

The papers by Messrs. I. Langmuir and J. A. Orange on high-efficiency tungsten lamps before the American Institute of Electrical Engineers last week are of great importance and interest. They indicate the practical value which may attach to careful physical research when conducted with a utilitarian aim. It is a well-recognized fact in the science of radiation that a solid body such as an incandescent lamp filament must radiate a long invisible spectrum of dark heat before it reaches the temperature of visible red heat, and that at dull red heat the power which it radiates in the visible spectrum as light is very small compared with the power which it radiates in the invisible spectrum as heat. In other words, its luminous-radiant efficiency at dull red heat is very low. As the temperature is raised, the body becomes brighter and radiates more power in all parts of the spectrum, but relatively more in the luminous than in the non-luminous parts, and hence a larger percentage of the total power radiated is luminous, or is useful light. The higher the temperature of the body the more the total power, and the greater the percentage within the visible spectrum; moreover, the color of the light given out tends to be less red and more blue, a condition that makes for a close resemblance to sunlight. This condition of increasing luminous-radiant efficiency with rise in temperature goes on until the body fuses or disintegrates.

Drysdale's researches have indicated that 1 watt in white light, that is, entirely within the visible spectrum, gives about ten mean spherical international candles. Since the ordinary good carbon-filament lamp gives only about 0.25 mean spherical candle per watt, its luminous efficiency is less than 3 per cent, while the ordinary good tungsten-filament lamp with, say, ⅝ mean spherical candle per watt, has a luminous efficiency of roughly 8 per cent. The principle reason for the great advance of the tungsten over the carbon filament lies in the higher temperature of its operation. Neither filament is operated close to its fusing temperature. When an attempt is made to operate a tungsten-filament lamp at a terminal voltage greatly exceeding the normal, one may be able to secure perhaps twice the normal luminous efficiency, but the life of the lamp will be very short. Even at the normal voltage and luminous efficiency, the lamp bulb blackens in time and distinctly lowers the luminous output.

The papers under discussion show that what curtails the useful life of an incandescent lamp is evaporation of the filament. The rate of evaporation rises much faster than the temperature, so that the operating temperature has to be kept down to a point very distinctly lower than the fusing temperature in order to keep the filament from evaporating too rapidly. It was found, however, that when an inert gas, and especially nitrogen, was introduced into the lamp chamber, at about normal atmospheric pressure, the evaporation of the glowing tungsten filament was greatly reduced, so that the operating temperature could be raised markedly nearer to the fusing limit, with a great gain in luminous efficiency. It is pointed out that a new heat loss occurs in the nitrogen-filled lamp, namely, convection through the gas. With very thin filaments the loss of power by convection may more than offset the gain due to raising the temperature, but if the filament is fairly thick, or of relatively large diameter, the surface area is less in proportion to the power in the filament. Consequently, in such lamps, the gain due to the rise of temperature is much more than the extra loss due to convection. Moreover, by suitably shaping the filament and the lamp bulb, the evaporated tungsten is not deposited over the areas of glass wall where the bulk of the light is emitted but is convected away to the top, so that the principal walls do not blacken. The result of the investigation appears to be a thick-filament tungsten lamp, adapted to relatively low voltage and large current, producing about two mean spherical candles per watt at the terminals. For series street-lamp circuits, and also for powerful light sources at 110 volts, the apparent advantage of these new lamps is very marked, both as to efficiency and color.

Electric Lighting in Horticulture

An interesting report has reached us from abroad concerning a new set of experiments recently tried in the forcing of plant growth by electric light. The subject is an old one and the general result has always been of the same character, showing that additional hours of light unquestionably tend to push along the growth of plants. Sunlight, of course, is the great and potent stimulant of growth, but artificial light, in so far as it may be substituted for sunlight, is naturally to be expected to show similar results. The present experiments are a little unusual in that they were tried indoors in two exactly similar houses, one lighted naturally and the other having in addition to its natural lighting facilities an ordinary mercury arc lamp, which was placed in use about an hour before sunset and kept in service for approximately four and a half hours. The exposure and temperature of the two houses were alike, so that the results appear to have been strictly comparable. They were rather striking. In the first place it is reported that seeds of ordinary vegetables germinated considerably earlier in the electrically lighted house than in the other. This is one of those extraordinary results which have sometimes turned up before in similar sorts of experimentation, but for which no rational explanation can be offered. It is highly probable at least that the seeds were buried and it is highly improbable that any light rays reached them. Certainly the mercury arc gives no radiation except a certain amount of heat radiation which can penetrate earth even to a very small distance. It is possible that in this case the heat radiation of the lamp, which is considerable since its net efficiency is much lower than its radiation in the visible spectrum would suggest, undoubtedly might produce at least a small effect on lightly buried seed. Certainly one cannot fairly ascribe this particular effect to the light received, of which the character is perfectly well known.

In the case of the growing plants the various flowering specimens could be directly affected by the light and are reported as actually showing considerable increase in growth and much freer flowering than the similar plants in the unlighted house. A similar result reported for a strawberry bed which showed an increase of crop of some

25 per cent is equally understandable and are quite in line with some previous experiments. It would be extremely interesting to know what rays of the mercury arc were effective in producing the effect noted. One would naturally suppose that the light of the visible spectrum representing that range of radiation in which living things have been developed should be charged with whatever of benefit may be reached, for the radiation from a mercury arc in a glass tube is far from being strong in the ultra violet, giving rather less than sunlight having the same intensity of illumination. Whatever may be the actual stimulating rays in such a case, the main point is that from one sort of radiation or another apparently a very considerable beneficial effect was derived from four and a half hours extra lighting of the growing plants. Perhaps one may hardly expect the process to be an economical one in ordinary agricultural operations, but it certainly might be well worth trying in floral culture where, on account of the ordinary effect of the seasons, a little additional forcing may lead to a materially better price for the product. The experiments ought to be carefully repeated at some of our agricultural experiment stations so as to get, if possible, some quantitative results sufficient to settle the economics of the matter. Experiments of this kind are somewhat difficult to carry out and interpret, yet the results before us are sufficiently promising to justify some additional research.

Carbon Electrodes for Arc Lamps

In view of the recent improvements in coarse-filament tungsten lamps well adapted for street lighting, there can be no doubt that arc lamp designers will be stimulated to make advances in order to maintain a position of relative superiority in economy of light production, such as has belonged to them in the past. It would not be surprising if the new tungsten lamps proved, in this respect, to be the arc-lamp's best friend after all, because we have similarly witnessed the incandescent lamp and the gas lamp push each other upward, in rivalry for domestic lighting.

Even allowing the claims of champions for the new tungsten lamp that its white luminous efficiency reaches 20 per cent, there is still a vast difference between that value and the efficiency of a good dynamo-electric machine, so that there is a good prospect ahead for brighter and more efficient illuminants. Who knows but that some new discovery may, in time, make the tungsten lamp look like a tallow dip! Light sources which depend on radiant gases, instead of on radiant solids, are free from the law of dark-spectrum radiation. A gas is capable of radiating selectively in a single band, or group of bands, instead of in a long freight-train procession that runs far beyond the visual limit of observation. A gas of 100 per cent luminous-radiant efficiency does not, therefore, seem to be a physical self-contradiction, however difficult or beset with limitations it may be to realize.

The article by Mr. A. T. Baldwin, which we print on page 793, describes very fully the composition, methods of manufacture, physical nature and operating characteristics of carbon electrodes, as used in the modern arc lamp. Many of these particulars are not easy of discovery by the man who is unconnected with arc-lamp manufacture. It will be observed that the figures claimed for the luminous efficiency of some of the inclosed flaming arcs, referred to the true-arc power, are very high.

The Direction of Advance in Diagrams

Discussion has recently been directed, in the columns of the *Elektrotechnische Zeitschrift*, to the question whether the decision unanimously adopted at the Turin meeting of the International Electrotechnical Commission in 1911 as to the conventional direction of phase advance in alternat-in-current vector diagrams is the best that could have been made. Articles have been presented on the subject by Messrs. Görges, Breisig and Wagner, Emde, and Richter. These articles are not in agreement, some of the writers taking the view that the I. E. C. convention is right and others the view that it is wrong.

On considering the arguments on the two sides of this much-debated question, it is evident that there are not only several different points of view but also several different conceptions attached to a vector diagram in the minds of different writers, such as purely mathematical relations between vectors on the one hand and structural relations in the windings of rotating machinery on the other. It is practically impossible to have a conventional direction of phase advance which will satisfy at once all these different needs and conceptions. One direction of rotation will satisfy some, and the other direction of rotation will satisfy the others. One is reminded of Socrates' answer to the young man's inquiry as to whether marriage was desirable or no; namely, to do just as he preferred, because whichever way he acted in the matter he would be likely to regret it.

The Turin rule has made positive or counterclockwise rotation the direction of phase advance, which is logical. It has not pleased everyone, but it has pleased the majority, and it was unanimously adopted by the I. E. C. It has largely been adopted, to the great relief of the bewildered student of alternating-current technology. It effects an exact anology between the established phase representation in the mathematics of vibrations in the mechanics of rigid vibrating bodies and in the electrics of alternating-current circuits. It preserves the same direction of measuring an angle in the circle and in the hyperbola as applied to alternating-current circuits with distributed constants. When, therefore, vector diagrams are presented without remark, the Turin convention should be, and practically is, taken for granted. But if, for any reason, a writer finds himself hampered by the Turin convention, then he cannot be constrained from working the other way round. But in any such case he should clearly, and beyond all peradventure, disclose his heterodoxy. Moreover, as the *Elektrotechnische Zeitschrift* discussion has shown, the mere addition of a curved arrow on the diagram is not sufficient to make the intent of the writer clear. He should explain explicitly. The question was raised casually at the recent I. E. C. meeting in Berlin and was there closed substantially in the manner here indicated.

The News of the Week

**Activities and Events in the Electrical Field—
Reports of Meetings—Commission Findings, Etc.**

Rate Expert Argues Against Going Value

Mr. Edward W. Bemis, public utility expert, appeared before the Chicago City Council committee on gas, oils and electric light on Oct. 10, by invitation, to discuss some features of the report of Mr. Ray Palmer, city electrician, on the Commonwealth Edison Company in the rate-investigation case. Mr. Bemis confined his remarks almost entirely to going value. He advised the committee not to fix rates for a period longer than three years, as the electric-service industry is progressing rapidly in the matter of effecting economies. Mr. Bemis does not believe in allowing going value in rate cases. Of the five older rate-regulating commissions in the country—Massachusetts, Interstate Commerce, the two in New York State and Wisconsin—he said, only the Wisconsin commission has allowed going value. Of the more recent commissions, New Jersey and some of the other states have also allowed it. The state courts differ on the question, but the trend of decisions in the United States courts seems to be against allowing the capitalization of going value. Mr. Bemis said that the action of the committee would have more than local influence and he urged the aldermen not to endorse the dangerous principle of capitalizing going value for rate-making purposes.

Convention of Railway Electrical Engineers

The sixth annual convention of the Association of Railway Electrical Engineers will be held at the LaSalle Hotel, Chicago, Oct. 21 to 24. It is expected that this will be the largest meeting ever held by the organization, and that all the principal railroads of the United States and Canada will have representatives present. Following is an advance program indicating the order of business:

Tuesday. Morning—Business session, and report of committee on standard reports for operation. Afternoon—Reports of committees on terminal facilities for handling car-lighting equipment, on head-end equipment and on electric head-lamps.

Wednesday. Morning—Reports of committees on methods of charging storage batteries, on standards, on dynamo suspension, on car-lighting reports, and on lamp specifications. Paper, "Incandescent Lamps," by Mr. Preston S. Millar. Afternoon—Reports of committees on wire and cable specifications, on wiring installation, and on outside construction and yard lighting.

Thursday. Morning—Reports of committees on illumination and on shop practice. Afternoon—Demonstration of new appliances by supply manufacturers. Papers, "The Gas-Electric Truck," by Mr. Joseph, and "The Electric Truck for Handling Freight," by Mr. T. V. Buckwalter.

Friday. Morning—Report of committee on data and information, and question box. Election of officers.

In connection with the convention a comprehensive exhibit of railway electrical apparatus will be displayed on the top floor of the hotel, which has been reserved for this purpose. Mr. D. J. Cartwright of the Lehigh Valley Railroad, is president of the Association of Railway Electrical Engineers, and Mr. Jos. A. Andreucetti, general foreman, Chicago & Northwestern Railroad, Chicago, is secretary-treasury.

Convention of Texas Power Company Managers

A convention of the plant managers of the properties operated by the Texas Power & Light Company, whose headquarters are at Dallas, was scheduled to be held at Waco, Tex., Oct. 9 and 10. Following is the program, as announced by Mr. F. R. Slater, general superintendent of the company: Thursday morning—Address of welcome by the Mayor of Waco, followed with addresses by Messrs. W. B. Head, assistant general manager of the company; J. F. Strickland, president, and George S. Haley, vice-president. Thursday afternoon—Paper, "The 190 Miles of 60,000-Volt Transmission Lines of the Texas Power & Light Company," by Mr. W. G. Schmauder, superintendent of power. Friday morning—Paper, "Commercializing the Electric Light and Motor-Service Business," Mr. Hartwell Jalonick, commercial manager. Friday afternoon—General discussion and answers to the Question Box.

Society for Electrical Development "Pioneer Member Week"

It has been decided to make an extraordinarily vigorous campaign for membership in the Society for Electrical Development during the week beginning on Monday, Oct. 27. The officers and directors of the society, its more than 600 members, forty-five Jovian Leagues and 12,000 members of the Jovian Order will concentrate their efforts to enlarge the society's membership to the best of their ability during the six days mentioned. The society is growing rapidly but is still some thousands of dollars short of the $200,000 required before its active work can begin. It is believed that the personal efforts of all those actively interested in the commercial development of the electrical field, concentrated in this short period of time, will go far toward bringing about the desired results.

Kansas Contractors Discuss Business Methods

The Kansas Electrical Contractors' Association met at Hutchinson, Kan., Oct. 9 to discuss the relations of manufacturers, contractors, jobbers and dealers. The association was organized in Topeka last May as a section of the National Electrical Contractors' Association, and at that time the following officers were elected: President, Mr. E. L. Staley, Wichita; vice-president, Mr. I. C. Bushong, Ottawa; secretary, Mr. J. A. Mercer, Topeka, and treasurer, Mr. J. R. Woodhouse, Atchison.

At the Hutchinson meeting Mr. W. R. Meeks, of Eldorado, Kan., was appointed as a committee of one to confer with the national secretary to devise methods for the prevention of improper selling practices.

The grievances expressed at this meeting were similar to those which have been aired in other sections of the country; namely, direct sales by manufacturers to retail buyers and central-station competition. The Kansas association is attempting to divide the electrical industry into four branches or classes, manufacturers, jobbers, contractors and central stations, its aim being to make the jobber the middleman between the manufacturer and the retailer, central station and contractor.

About thirteen contractors now belong to the Kansas association, but this membership, it is asserted, represents about half the contractor's purchasing power in Kansas. The next meeting will be held in May.

A. I. E. E. Affairs

At the regular monthly meeting of the board of directors of the American Institute of Electrical Engineers, held in New York on Oct. 10, President C. O. Mailloux was authorized to change the organization of the electric power committee by substituting for the sub-committee on prime movers, a committee on power generation, and to make the committee on prime movers an independent committee.

President Mailloux announced the following additional committee appointments: Power generation, Mr. H. W. Buck, chairman; technical lectures, Prof. W. I. Slichter, chairman; engineering co-operation, Dr. William McClellan, chairman.

Upon the petition of the Panama members of the Institute, and the recommendation of the sections committee, authority was granted to organize an Institute section in the Canal Zone, to be known as the Panama Section.

In response to an invitation from the National Conservation Congress, the president was authorized to appoint five delegates to represent the Institute at the Fifth National Conservation Congress, to be held in Washington, Nov. 18 to 20, 1913.

Upon the recommendation of the executive committee of the International Electrical Congress, President Mailloux was authorized to reorganize the executive committee with a chairman and vice-chairman, with the several members of the committee serving also as chairmen of the necessary sub-committees.

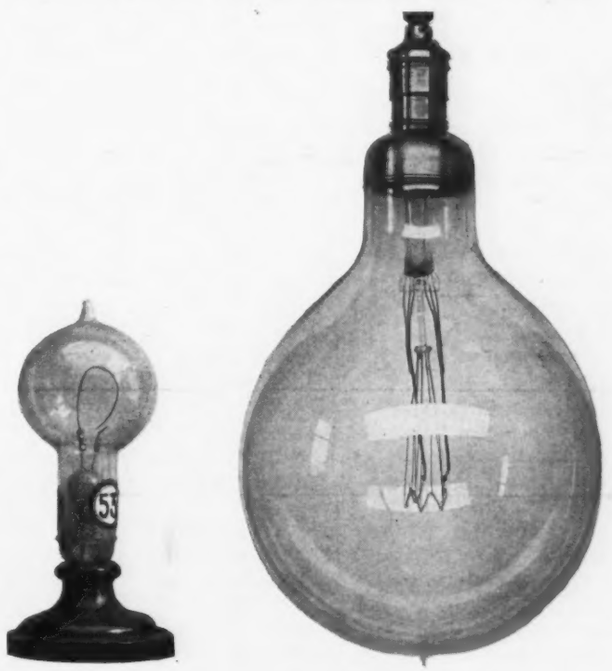
The executive committee of the committee on organization of the International Electrical Congress, San Francisco, 1915, reported that it had unanimously decided to invite Dr. Charles P. Steinmetz to accept the position of honorary president of the congress and Dr. E. B. Rosa to accept the position of honorary secretary of the congress. This action was unanimously approved and confirmed by the board of directors.

Convention Program of the Electric Vehicle Association

The program for the annual meeting of the Electric Vehicle Association of America, to be held in Chicago, Oct. 27 and 28, has been announced as follows: President Arthur Williams' address at the morning session of Oct. 27 will be followed by the reports of the secretary and the treasurer and the various committees. Mr. John F. Gilchrist, chairman of the committee on rates and charging stations, will report the work of his committee. At the afternoon session reports on "What the Sections Are Doing" will be presented by Mr. Homer E. Niesz for the Chicago Section; Mr. J. A. Hunnewell for the New England Section; Mr. Harvey Robinson for the New York Electric Vehicle Association, and Mr. Day Baker for the Electric Motor Car Club of Boston. "Traffic Problems and the Automobile" will be discussed by Dr. E. E. Pratt, manager of the industrial bureau of the Merchants' Association of New York; "The Merchant, the Central Station and the Electric Truck" will be the subject of Mr. F. Nelson Carle's paper; and "Co-operation Between the Electric Vehicle Manufacturer and the Central Station" will be presented by Mr. E. L. Callahan. The nominating committee will make its report at Tuesday's session, after which the following papers will be presented: "Charging of Storage Batteries in Unattended Garages," by Mr. Maxwell Berry; "Electric Vehicle Salesmanship," by Messrs. George H. Kelly and E. J. Bartlett; and "The Electric Vehicle in Department Store Service," by Messrs. C. A. Duerr and David F. Tobias, and "Recent Developments in the Lead Battery for Electric Vehicles," by Mr. Bruce Ford. The election of officers will terminate the morning session. In the afternoon Mr. F. E. Whitney will discuss "Electric Commercial Vehicle Tires" and Mr. Frank W. Smith will make a report of the publicity and advertising committee. The session will be concluded with a talk on "How to Make the Business Healthy" by Mr. Ralph Temple.

Anniversary of Incandescent Lamp

The thirty-fourth anniversary of the birth of the Edison incandescent lamp occurs on Tuesday, Oct. 21, for it is recorded that on Oct. 21, 1879, Edison, after many patient trials, carbonized a piece of cotton sewing thread bent into a loop of horseshoe form and had it sealed in a glass globe from which the air was afterwards exhausted. This lamp when put on the circuit lighted up brightly to incandescence and maintained its integrity for over forty hours. This was considered to be the first practical incandescent lamp. Shortly afterwards Edison's famous "paper horseshoe" lamp appeared, which was considered by many to have been the first thoroughly commercial lamp, and of which some 700 or 800 were installed in the Edison laboratory and workshops, dwelling houses and through the streets of Menlo Park, N. J. The filament of this lamp was cut



FIGS. 1 AND 2—PAPER HORSESHOE FILAMENT LAMP OF 1879 (ONE-THIRD SIZE) AND 5000-CP TUNGSTEN-FILAMENT, NITROGEN-FILLED LAMP (ONE-SIXTH SIZE)

out of a piece of bristol board, which in carbonizing shrunk about one-third in size. Before arriving at this form, which gave place to the well-known carbonized bamboo filament lamp which in later years was superseded by the squirted filament type of lamp still used to-day, Edison had in common with various other inventors experimented with incandescent platinum as an illuminating agent. Lamp filaments were also made of thread rolled in tar, from graphite and of many kinds of vegetable fibre. From the first Edison aimed to make each of his lamps an independent

unit, consisting of a high resistance filament sealed in a glass receptacle with platinum leading-in wires.

Little is known of the characteristics of the first incandescent lamp. Edison's carbon filament lamp had a resistance of 140 ohms hot and more than twice that when cold. With such a high-resistance filament he was enabled to connect his lamps across the electrical conductors like rungs in a ladder, and did not require large conductors as each unit only took a small amount of current. These conditions were essential to the commercial success of the incandescent lighting system. Fig. 1 herewith shows one of the first paper horse-shoe filament lamps contained in the Hammer historical collection set up in the Engineering Societies Building, in New York. The engraving shows the lamp one-third its actual size. Fig. 2 shows the latest development in incandescent lamps, a 5000-cp tungsten filament in a nitrogen filled bulb. The latter lamp is shown one-sixth its actual size and does not necessarily represent the final commercial form of this type of lamp, having been made especially for the Electrical Show now being held in New York. The past and the present types of lamp are shown side by side, the tungsten lamp for the time being representing the survival of the fittest. With its specific consumption of one-half watt per candle there would appear to be little excuse for the existence of the other types of lamps. However, there are still possibilities for the carbon-filament lamp.

High-Tension Transmission Line Not Dangerous

A number of property owners of Chesterfield County, Va., failed in their effort before the State Corporation Commission on Sept. 24 to prevent the use of the right-of-way of the Seaboard Air Line Railway between Richmond and Petersburg for a high-tension transmission line. The line was erected by the Virginia Railway & Power Company, of Richmond, for transmitting energy generated at the falls of the Appomattox River to Richmond manufacturing plants, and it was so arranged that in the event of the breakdown of the Petersburg power house energy from Richmond could be instantly supplied there for lighting and other purposes. An extended written opinion was handed down by Judge Prentis, chairman of the Corporation Commission, in which it was brought out that by an agreement dated Aug. 22, 1912, the Seaboard Air Line Railway Company had leased to the Virginia Railway & Power Company the right to operate a high-tension transmission line with iron towers to carry energy with a potential as high as 110,000 volts from Kingsland Creek to Richmond. The petitioners claimed that they have occasion to use the railway for passenger and freight traffic and that they also own farming and park lands through which the transmission lines pass. They maintain that the transmission of high-tension energy is dangerous to life and property and is liable to interfere seriously with telephone and telegraph lines used for dispatching trains, and that generally such use of the right-of-way of the railway company was not contemplated in the company's charter or in the condemnation proceedings under which the line was acquired.

In answer, the defendant companies maintained that the contracts were a proper exercise of the rights of the two corporations, and they denied that the construction of the line constituted any danger or menace to the petitioners or to the traveling public. The Virginia Railway & Power Company asserted that the transmission line, which is of the suspension-insulator type, is the safest known to electrical science and affords complete protection and safeguard from accident and injury. Having disposed of the legal objections from both sides, Judge Prentis discussed the facts as to the dangers alleged as brought out in the evidence, saying that while the apprehensions of the petitioners in the present state of knowledge or lack of knowledge with reference to electricity were probably natural, he believed that they were unfounded in fact. From consideration of all the testimony he stated that the only appreciable danger to human life would be encountered in case one climbed to the top of one of the towers and touched one of the transmission lines, in this way completing the circuit and causing a current of electricity to pass through his body and into the ground. The touching of the towers by men or animals is not dangerous under normal conditions, and even under abnormal conditions the electricity would go through the tower by the most direct pathway which offered the least resistance to the ground, that is, through the grounded towers, and not through the body of the person touching the tower. As many lines carrying high voltages are in operation along railroad rights-of-way and even along street of cities, the commission concluded that the petitioners had failed to establish the allegation that the line is a menace and a danger to the public.

The petitioners made an effort to prevent the construction of the line before the Chesterfield County Court, but, after hearing in the case, this was abandoned and the fight taken to the State Corporation Commission. A part of the line has been in operation for about two years, and the contested part has been in operation since the latter part of June, 1913. The electrical experts for the defendants were Messrs. P. W. Sothman, of New York; F. D. Samson, superintendent of distribution for the Southern Power Company; T. A. Worcester, of the General Electric Company, and J. G. Stribling, superintendent of distribution of the Virginia Railway & Power Company.

N. E. L. A. Executive Committee Meeting

At the meeting of the executive committee of the National Electric Light Association held in New York, Oct. 3, the total membership was reported as 12,557. Vice-President H. H. Scott, chairman of the committee on organization of the industry, offered three prizes of $25, $15 and $10 respectively for the best contributions giving ten reasons why membership in company sections is desirable. The contributions must be submitted on or before Dec. 1, 1913, and the prizes are open to all members of company sections.

Owing to numerous requests from outside sources for the Meterman's Handbook it was decided to make the handbook available for schools, colleges and other educational institutions at the price charged to members. The Eastern New York Section recommended that a suitable hero medal be awarded to the person who resuscitates a comrade by means of the prone-pressure or other method of artificial respiration. The plan was approved and referred to the resuscitation commission.

President J. B. McCall reported that the overhead line construction report printed for the New York convention in 1911 was out of print and inasmuch as the present committee is working on a revision of the fourth section of the report dealing with crossings it had been decided not to reprint the original. He suggested, however, that attention should be called to the fact that changes are being made in order that any public service commissions contemplating its adoption would defer the matter until the revised edition is ready. To avoid any misunderstanding the resolution passed at the meeting of Dec. 7, 1911, in which the executive committee commended the report of the overhead line construction committee to the favorable consideration of member companies, was read. In that resolution it was pointed out that local conditions or special considerations may in particular cases make the adoption of the recommendations of the report in whole or in part impracticable or inadvisable, so that non-compliance therewith in such cases would not necessarily be bad practice.

Mr. W. H. Blood, Jr., presented a plan whereby the Independence Inspection Bureau of Philadelphia would furnish regular bulletin service and lectures on fire and accident prevention to class A members. It was voted that the issuance of the fire bulleting be approved and carried into effect as soon as Messrs. W. H. Blood, Jr., and T. C. Martin could get subscriptions of $2500 toward the expense, it being recommended to the companies that they contribute enough to have a copy of the bulletin sent each month to their plants.

Preliminary arrangements are being made in Philadelphia for the 1914 convention of the association, and President McCall outlined the plan for celebrating the thirtieth anniversary of the first electrical exposition in this country, which was held in Philadelphia in 1884. In speaking of the 1915 convention President McCall said that Vice-President J. A. Britton, of San Francisco, whose plans to attend the meeting had gone awry, had advised him of the necessity of making reservations both for hotel accommodations and convention halls at once. The executive officers were empowered to make the necessary arrangements for space and it was decided to advise Mr. Britton that the attendance from east of the Rockies would probably be about 1500. At the luncheon which followed the meeting, Mr. G. W. Elliott, master of transportation, discussed several points connected with the transportation arrangements for the Philadelphia convention and particularly for the San Francisco meeting.

Graduation from Electrical Courses in the United States

In accordance with plans carried out during the past seven years we give herewith certain statistics relating to the students in and graduates from schools in the United States conducting systematic courses in electrical engineering. Statistics for the earlier years appeared in our issues dated July 27, 1907, Dec. 26, 1908, Feb. 10, 1910, Dec. 22, 1910, Nov. 11, 1911, and Nov. 23, 1912. It will be noted that in some cases the data herein given for 1912 differ from the data recorded in our issue of Nov. 23, 1912, for that year. The difference is attributable in part to the slight increase in the number of schools in the present list, thereby including data for 1912 not previously reported, and more largely to revision in the statistics relating to graduates, the actual rather than the predicted number being used in the present 1912 group.

TABLE I—STATISTICS OF POST-GRADUATE AND UNDERGRADUATE STUDENTS IN 1912 AND 1913

Year	Class	Freshmen	Sophomore	Juniors	Seniors	Post-graduates	Total Students	Graduates	Total Graduates to June, 1913
1912	First.....	1113	866	728	604	122	3433	611	9,321
	Second....	1538	1034	775	685	47	4079	530	7,556
	Third.....	522	378	267	221	21	1409	301	2,803
Grand totals....		3173	2278	1770	1510	190	8921	1442	18,680
1913	First.....	1069	833	767	591	113	3373	533	9,854
	Second....	1598	1103	808	674	101	4289	598	7,154
	Third.....	475	366	366	276	3	1486	235	3,038
Grand totals....		3142	2302	1941	1541	217	9143	1366	20,046

As will be seen from Table I, reports have been received from 115 schools, more than one-half of which have been placed in the middle class. In Class I have been included twenty-five schools of the highest standing, the degrees from which confer more or less prestige on the graduate. Class III includes nineteen schools in which the instruction is quite elementary, but which have regularly organized courses of instruction in electrical engineering.

It is noteworthy that so far as total numbers of students and graduates are concerned there has been practically no change during the past seven years. There was a slight increase in the number of students in 1913 over 1912, and a slight decrease in graduates during this period, but the figures for both 1912 and 1913 do not differ greatly from those of 1907 or the intervening years. The past three years have witnessed a steady increase in the number of students taking post-graduate courses, the figures being 166 for 1911, 190 for 1912 and 217 for 1913.

TABLE II—ELECTRICAL ENGINEERING STUDENTS AND GRADUATES

	Number of Schools	Students 1912–13	Graduates 1913	Total Graduates to June, 1913
Class I.....	25	3373	533	9,854
Class II.....	71	4284	598	7,154
Class III.....	19	1486	235	3,038
Totals.....	115	9143	1366	20,046

Almost exactly 20,000 students have graduated from electrical engineering courses in the United States, practically one-half this number having received their degrees since 1906. It is safe to assume that at least 40,000 have entered the freshman classes and received instruction for from one to four years. Students who do not continue their courses until graduation profit by their training and many become active factors in the industrial progress of the country. It is fair to estimate that on the basis of years of training given by the electrical engineering schools the equivalent of trained men is 30,000 rather than 20,000. Not all of these men continue in engineering work. In fact, a large number of them enter other lines, but few indeed are those who do not find their technical training useful in their life work.

TABLE III—COMPARISON OF STATISTICS FOR SEVEN YEARS

Year	1907	1908	1909	1910	1911	1912	1913
Number of students.....	8929	9651	8670	9041	9515	8921	9143
Number of graduates....	1358	1501	1473	1545	1614	1442	1366

Permit Issued for California Power Development

A water power permit has just been granted by the secretary of agriculture to the Truckee River General Electric Company, a California corporation, under which that company will develop power on the Eldorado national forest, to serve various California towns and cities. The company expects to construct seven reservoirs, five for water storage and two for equalizing the flow. Two of the storage reservoirs are on upper Rubicon River. By the use of a tunnel, approximately a mile and a half long, the flow of the upper Rubicon River and the waters stored in the two reservoirs will be brought into the Gerle Creek drainage, where the waters will be further stored. From this storage the water will be conveyed by ditches and natural streambeds to Pilot Creek, upon which the two power plants mentioned in the permit are to be located. The water will finally be discharged into the Rubicon River. At each of the two plants there will be a head of approximately 1300 ft. The company expects to make an initial installation which will develop about 16,000 hp., which will probably be doubled as the market for the product increases. The headquarters of the Truckee River General Electric Company are at Reno, Nev.

Floods Threaten Power House at Houston, Tex.

At Houston, Tex., during the last twenty-five days of September 18 in. of rain fell, of which downpour nearly 12 in. fell during the last seven days. The result was a severe flood which inundated the low sections of the city and for a time threatened to destroy the Houston Electric Company's fuel house, 50,000-gal. water tank, and even the plant itself. A torrent from a broken sewer attacked the earth bank on which the station stands and was rapidly eating it away when Mr. David Daly, manager of the company, set a force of thirty men at work covering the earth bank with tarpaulins weighted with rails, digging ditches and building cofferdams of sand-bags. Two of the company's three generators were put out of commission, and for several days local street-car service was impaired.

New York Electrical Show

The Electrical Exposition and Motor Show of 1913 opened its doors to the public at the Grand Central Palace, New York, on Wednesday night of this week. Over 100 separate exhibits, some very large and some very small, are spread over three floors of the immense building, which has been suitably transformed for the occasion by Mr. M. A. Singer, the well-known decorator. Lexington Avenue, on which the Palace fronts, is illuminated at night from Forty-second Street to Forty-seventh Street by twin flaming-arc lamps, so that even in the great city of New York those in the vicinity of the Grand Central Station and of the Palace,

FIG. I—SECTION OF NEW YORK ELECTRICAL SHOW

four blocks away, will be attracted by the greater illumination obtaining during the show in that section of the city. Lined as the Grand Central Palace is with monumental columns which are decorative in themselves, it is impossible to obtain a general view of the entire exhibition and it is only by wending one's way in and out among the booths that any comprehension of its size and scope is obtained. The booths are uniform and artistic in arrangement, the color tone being French gray, so that with the great quantity of light used, the dominating impression obtained is that of immaculate cleanliness minus the usual coldness which is associated with cleanliness.

The government is well represented by exhibits of more than passing and of immense popular interest, the Agriculture, Commerce and Labor, Navy, Army and Treasury departments all contributing, as well as the State of New York and the Bureau of Municipal Research. In the domain of therapeutics much that is of importance in model hospital work is portrayed. In addition to a model hospital shown by the New York Edison Company's electro-therapeutic bureau there are twelve exhibits made by manufacturers of medical apparatus. The commercial and industrial exhibits are numerous and varied, almost every manufacture of importance being represented, and it is difficult to think of an electrical device intended for the home which is not shown. Demonstrations and working exhibits are scattered throughout the entire show, which embraces everything from an electric iron and toaster to an army wireless pack wagon and a model mint. Nor are spectacular show features lacking, for on the third floor is an electric farm and dairy where cows are milked, butter churned, chicks hatched, etc., by electricity. Of course all of the central stations in the vicinity have exhibits of special interest to the householder for whose benefit the show is chiefly given, and below are given brief descriptions of the booths maintained by the lighting companies.

NEW YORK EDISON COMPANY'S EXHIBIT

The exhibit of the New York Edison Company is scattered throughout the building. The motor service department is showing an electric farm on which electrically operated incubators hatch chicks and ducks. Motor-driven devices for milking cows are also shown in operation. In the model print shop of the company a daily newspaper chronicalling the events of interest about the show is published three times daily. The bureau of electrotherapeutics has arranged a hospital in which are displayed nearly all of the electrically operated devices now in use. In another portion of the building the cooking and heating department operates a restaurant where everything is cooked by electricity. A model laundry equipped with washing and wringing machines and other devices for making housework easy is a feature shown elsewhere. The educational bureau of the company exhibits the work of its scholars, showing the progress made under the company's instructors. The illuminating engineering department has devised a scheme whereby any patron so desiring can be shown the relative light-giving qualities of lamps. At the booth of the advertising bureau many of the Cooper drawings of the New York company's "at your service" man are on exhibition.

EXHIBIT OF THE BROOKLYN EDISON COMPANY

The booth of the Edison Electric Illuminating Company of Brooklyn is divided into three portions. In the central portion is shown the $49 house-wiring plan which the company is offering its patrons. A parlor, dining room, kitchen and hall are wired complete with fixtures and lamps as called for under this contract. One of the other portions of the booth at the right contains a demonstration arranged to show what 10 cents' worth of electricity will do in Brooklyn when used with any of the modern lighting, heating or cooking devices. Each device in this exhibit is suitably tagged with a card giving the specific work which the device will do when supplied with 10 cents' worth of electrical energy. For instance, the toaster carries a placard stating that 120 slices of bread can be toasted for 10 cents; a 500-watt lamp can be burned for two hours, 20 cigars may be lighted electrically each day in the year, tea for six can be made each day in the week, etc. At the other end of the model house the motor-service department has an exhibit of small motors, each of which is labeled with a display card in the same manner as the household devices. This portion of the booth is intended to show a manufacturer just how much work can be accomplished in several particular lines with motor-drive for 10 cents.

UNITED ELECTRIC LIGHT & POWER COMPANY'S BOOTH

At the booth of the United Electric Light & Power Company visitors are received in a small reception room and

conducted to the central portion of the booth, which is equipped with small tables and chairs made to resemble as nearly as possible a model electric grill room. In this room a brilliantly lighted electric fountain forms a pretty center setting for the scene and its attractiveness is doubled by means of surrounding mirrors. The food served to the guests at the electric grill is all prepared in an adjacent

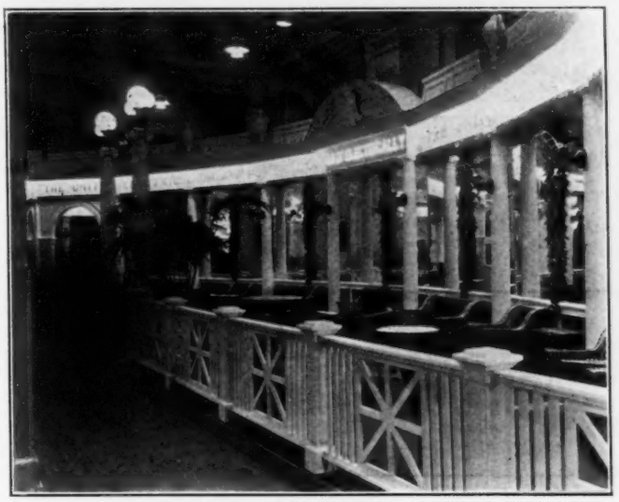


FIG. 2—BOOTH OF UNITED ELECTRIC LIGHT & POWER COMPANY

electrical kitchen, where modern electrical household devices are displayed in operation. In the office of the company, which is situated near the reception room of the booth, the company's $69 house-wiring plan and its special offer on 500-watt tungsten lamps are placarded.

NEW YORK AND QUEENS ELECTRIC LIGHT & POWER COMPANY'S BOOTH

Queens, the factory district of New York, is making a strong effort to induce manufacturers to buy sites and locate their plants in that borough. In the booth of the New York and Queens Electric Light & Power Company are shown many suitable factory sites and also views of

FIG. 3—BROOKLYN EDISON BOOTH

many successful plants which are now in operation on the company's circuits. All of the latest developments, including the railroad which is now about to connect Queens with Manhattan are pictured. In addition, domestic appliances are tastefully displayed about the booth. Stereomotorgraphs, illuminated color pictures, signs, charts, etc., show also the suburban sections of Queens.

BOOTH OF THE YONKERS ELECTRIC LIGHT & POWER COMPANY

The Yonkers Electric Light & Power Company, supplying electrical energy to patrons in an area of more than 22.5 sq. miles just outside Greater New York, is exhibiting in its booth statistics showing the growth of the company during the past few years together with pictures of many attractive homes using electric service in that suburb. As Yonkers is neither a manufacturing nor a residential district exclusively, an attempt has been made at the company's booth to interest all of the patrons.

The exhibition will close Oct. 25.

Eleventh Annual Jovian Congress

The eleventh annual Jovian congress opened at the Hotel Astor on Oct. 14 with an address of welcome by Mr. Frank E. Watts, reigning Jupiter of the Jovian order. Mayor Kline, of New York City, who was to have delivered the address of welcome, was unable to attend owing to the urgency of municipal matters. In his address, Mr. Watts spoke of the rapid growth of the order, which is now one of the largest electrical associations in the country. He also expressed the hope that the congress would represent more than a convention of Jovians for pleasure, and added that, in his opinion, there is much real work to be done which falls within the scope of the order. Closer attention by the various statesmen to the work of the local societies was suggested as one of the ways to solve local problems and maintain enthusiasm in the order.

Owing to the absence of Mr. E. W. Robertson, of Buffalo, past Jupiter No. 6, the response to the address of welcome was given to Mr. H. F. MacGregor, past Jupiter No. 2, of Houston, Tex. Mr. MacGregor spoke of the early days of Jovianism, and reviewed the growth of the order from its inception in Texas. Committees were then appointed as follows: Resolutions, Messrs. Frank D. Beardslee, St. Louis, chairman; E. H. Waddlington, Chicago; Charles Martin, Dallas, Tex. Nominations, Messrs. George W. Elliott, New York, chairman; Henry Harris, Pittsburgh; W. E. Robertson, Buffalo; J. R. Crouse, Cleveland; A. E. Loeb, Columbus, Ohio. Secretary's report, Messrs. Sam A. Hobson, Chicago, chairman; T. H. Bibber, New York; Fred. Johnson, St. Louis. Jewelry, Messrs. Robert L. Jaynes, Pittsburgh, chairman; W. D. Shaler, Pittsburgh, and Mac Sterrett, Dallas, Tex. The committee on degree team work included all of the past Jupiters present at the convention.

PAST JUPITERS' ASSOCIATION

At the business meeting on Wednesday morning Mr. J. Robert Crouse, of Cleveland, presented the report of the association of past Jupiters. He stated that the past Jupiters' fund amounted to $4000, all of which had been donated voluntarily by the members of the Jovian order. He also outlined a plan which is to be followed in using the interest accruing from this money. For the first ten years neither principal nor interest is to be expended for any purpose, and during the second 10 years 10 per cent. of the interest will be used for such purposes as the past Jupiters acting for the Jovian order elect. During the third ten years 20 per cent. of the earnings will be used, and this method of procedure will be followed until three-quarters of the earnings of the investments are being used, at which time no further increase in the amount of interest expended will be made. Of the present funds 50 per cent. is invested in gilt-edged securities, 25 per cent. in stocks, 15 per cent. in ventures of a more speculative nature, and 10 per cent. is held as a cash reserve. All of the investments are made in stocks and bonds of the largest manufacturing and central station companies in the electrical industry.

JOVIAN ACTIVITIES

The report of Mercury Ell C. Bennett, St. Louis, was divided into two parts, the first of which covered the work of the present administration. In this report Mr. Bennett spoke of the increased Jovian activity following the extensive tour of Reigning Jupiter Watts across the continent and remarked that the money spent by the order in traveling expenses had produced results. Trips made by Mercury Bennett himself were also followed by increased activity in the cities which were visited. The *Jovian Year Book* will be available about Jan. 1. There are at present 52 Jovian luncheon leagues in the United States and Canada, many of which are splendidly organized and effective. A very gratifying result of this year's work is evidenced in the activity on the Pacific Coast, in Canada, and in the renewed interest in Texas. Following a suggestion made at the last annual meeting, Mercury Bennett has been in communication with persons in England with a view to establishing Jovian chapters in that country. This investigation has not yet reached a point where it would justify the expenditure of money for an envoy to that country. However, the investigation is being continued and will be reported on later.

In accordance with the resolution passed by the eleventh congress the Jovian order has undertaken to secure subscriptions for the Society for Electrical Development. As an appreciation of their interest the society has offered a prize of $500 to the Jovian league securing the largest number of subscriptions, and in addition to this a prize of $250 to the Jovian securing the largest number of subscriptions, $150 to the individual next highest, and $100 to the third. Up to the present forty-five statesmen have indicated their intention to engage in the campaign.

MEMBERSHIP AND FINANCES

During the tenth administration 3535 new members, or 2218 more than in any previous year, were initiated. The eleventh administration now reports a still more remarkable increase, as it has at present initiated 3442 members and has still to hear the results of six rejuvenations. Mercury Bennett states that the last potential issued during this year will be approximately 12,100; that is, the present membership of the society is approximating 12,000. Owing to the fact that a number of rejuvenations had not been reported, the financial statement, although incomplete, showed that an approximate balance of $8000 would be turned over to the next administration after all deductions, including more than $900 for the Past Jupiters' fund, had been made.

SUGGESTION REPORT

From the ideas sent in to the central office of the Jovian Order at St. Louis, Mr. Ell C. Bennett compiled the second part of Mercury's report, which he called the "Suggestion Report." In this were ideas and suggestions intended to be helpful in improving Jovian efficiency. Recognizing that the importance of the Jovian Order rests upon its success in establishing many and capable local organizations, much stress was laid upon the necessity for expansion in this direction.

Some Jovians believe that the order should be purely social in nature, and, according to Mr. Bennett, this opinion is entitled to respect.

ORGANIZATION OF A COMMERCIAL DIVISION

The Jovian Order could never exist successfully without this social function, and this feature of the order must be guarded jealously and fostered. The commercial possibilities, he contended, must not be allowed to develop to a point where they dominate it, nor must the attempt ever be made to mix one with the other. However, if the Jovian Order is to grow and prosper, and command the time of men of affairs, it must find some other reason for its existence and a practical method of applying that reason for the good of the electrical industry.

Earnest study of the condition outlined, coupled with useful thoughts from a number of Jovians, has suggested a separate, authorized branch, which will make use of local organizations, for the double purpose of giving those organizations a greatly needed incentive, and of accomplishing results which will mean commercial advancement for every man in the electrical industry.

After adding this helpful suggestion Mr. Bennett offered his services to the Jovian Order as manager of the commercial division. This work he expects to carry along with the work which he is doing for the social section, giving up his other business connections. All he asked of the Jovian Order was that he be given the necessary authority and the office force to carry on the detail work. He recommended that no change be made in the present organization of the central offices and that none of the present employees be used for commercial division work. Mr. Bennett is at present formulating a plan whereby the commercial division can be made self-supporting.

GOOD-FELLOWSHIP COMMITTEE AND STUDENT MEMBERSHIP

Several instances were cited where the central office of the Jovian Order has rendered assistance to needy and worthy brother Jovians. It was suggested that the Jovian Order create a committee of good-fellowship, and that the reigning Mercury and secretary of the Past Jupiters' association act as members of this committee, which is to be supplied with the maximum of $500 a year to cover cost of investigating appeals for aid and to supply funds for the necessary help.

Statesman-at-large, Mr. P. Loyd Lewis, suggested admitting to Jovianism, on a decreased or postponed initiation fee, students of recognized institutions of learning who are studying electrical engineering and who intend to engage in the electrical or some allied industry after graduation.

COMMERCIAL DIVISION APPROVED

At Thursday morning's session the committee on the secretary's address reported favorably on the suggestions contained therein and recommended that the plans outlined by Mr. Bennett be placed in operation as speedily as possible.

Following the report of the committee addresses were made by men prominent in the electrical and other fields. Mr. Henry L. Doherty, president of the Society for Electrical Development, spoke on the co-operative work which the Jovian Order is doing in connection with the Society. The title of the address by Mr. Charles L. Eidlitz, of New York, was "The Truth, the Whole Truth and Nothing but the Truth." Dr. Lee Galloway, of the New York University School of Commerce, spoke on "Disorganized Distribution." A talk by Mr. James H. Collins, whose articles in the *Saturday Evening Post* have attracted much attention, concluded the morning's addresses.

ELECTION OF OFFICERS

Acting upon the recommendations of the nominating committeee consisting of Mr. George W. Elliott, chairman, and Messrs. W. E. Robertson, J. Robert Crouse, Henry Harris and A. L. Loeb, the following men were elected to the offices indicated:

Jupiter, Mr. W. N. Matthews, St. Louis; Neptune, Mr. M. F. Knapp, Pittsburgh; Pluto, Mr. T. H. Bibber, New York; Vulcan, Mr. A. H. Halloran, San Francisco; Avrenim, Mr. Louis V. Nogeuira, Dallas, Tex.; Hercules, Mr. George C. Rough, Toronto, Canada; Mars, Mr. E. A. Wilcox, Boise, Idaho; Apollo, Mr. George C. Richards, Chicago; Mercury, Mr. Ell C. Bennett, St. Louis, and Triton,, Mr. M. H. Jones, Baltimore. Jupiter is the president of the order, while Mercury is the secretary in charge of the central office.

Mr. W. N. Matthews, the Jupiter-elect of the Jovian

Order was born in St. Louis, Mo., July 9, 1869. He was educated in the public schools of the city and at Smith Academy. Early in life he started to work as an office boy in a wholesale drug house and while there his uncle, the late Admiral E. O. Matthews, invited him to accompany him on a cruise in Chinese waters on the *U. S. S. Brooklyn,* which was then the flagship of the Asiatic squadron. After living on the seas for a year young Matthews returned to St. Louis in September, 1887, and took up his work again in the drug business. There he remained until 1890, when he left to enter the electrical supply business as vice-president of the St. Louis Electrical Supply Company. In 1898 he sold out his supply business to start as a manufacturers' agent, representing at that time the H. T. Paiste Company and several other manufacturing companies. Out of that grew his present business as a manufacturer of electrical specialties. In 1900 Mr. Matthews took his brothers, Leonard, Jr., and Claude L., into partnership with him, his brother Leonard having since withdrawn from the firm. Mr. Matthews was one of the original members of the Electrical Supply Dealers' Association organized in 1906 and is at present vice-president of the St. Louis League of Electrical Interests. He was Apollo at the ninth Jovian Congress and was instrumental in

JUPITER-ELECT W. N. MATTHEWS

obtaining the services of the present Mercury, Mr. Ell C. Bennett, for the Jovian Order.

ENTERTAINMENTS

On account of its fraternal nature, the Jovian Order possesses means of entertainment not afforded by other electrical and engineering associations. On Wednesday afternoon the various degree teams held a competition in the work of "Rejuvenation," or initiation, of candidates. The team honors were awarded to the New York team, while the individual honor was bestowed upon Mr. Thomas Bibber for his impersonation of Pluto. The annual rejuvenation of the Order was held on Wednesday evening when 183 candidates were accepted as members. Following this exercise was a combined smoker, supper and vaudeville entertainment provided by the New York Edison Company in the Grand Central Palace, where the New York Electrical Show was being held at the same time. The concluding feature of the congress was the annual banquet at the Hotel Astor, during which the get-together fraternal spirit of the organization reached its climax.

The entertainments provided for the ladies consisted of a matinee on Wednesday afternoon and a recital in the evening by Mr. Edison's disk phonograph. On Thursday there was an automobile ride followed by tea at the Astor.

Convention of the American Electric Railway Association

The annual conventions of the American Electric Railway Association and its allied and affiliated Engineering, Accountants', Claims, Transportation & Traffic and Manufacturers' Associations were held at Atlantic City, N. J., Oct. 13 to 17. The attendance was, as usual, large, a total of 2839 members and guests being registered by the end of Oct. 15.

The sessions of all of the associations, which were well attended, were held on Young's Million-Dollar Pier. The meetings of some of the associations began on Monday and the concluding sessions were not held until Friday of this week. The programs were varied and, while they related generally to all matters of electric railway operation, they dealt to some extent with the larger questions of corporate policy which concern all of the public utility companies of every class in the country. Some of the matters which are of general interest to the electrical industry are mentioned briefly in the following notes:

Gen. George H. Harries, president of the American Association, referred in his address to the invitation extended to the committee on public relations by the public policy committee of the National Electric Light Association to meet at a dinner in New York on Feb. 19. Frank interchange of opinions combined with harmony of desire so that the outcome was an agreement to co-operate in the good work of public education. Pending the consideration of certain essential details, final action on the appointment of the joint committee proposed to conduct the co-operative work has not been taken, but the organization will be completed at once and, there is every reason to believe, be highly efficient.

The report of the commitee on public relations was presented before the American Association by the chairman, Mr. Thomas N. McCarter, Public Service Corporation of New Jersey. Reference was made to the conference held in New York in February with the public policy committee of the National Electric Light Association. The discussion was said to have been of great importance as developing the ideas of men prominent in both the electric railway and the electric light industry as to ways and means for bringing about what all are striving for, a better condition of affairs as between the companies and the public. The National Electric Light Association has already appointed its members of the proposed joint committee representing the two associations to devise means of effective publicity with respect to questions of public relations. The names of representatives of the American Electric Railway Association to serve on this committee will be announced shortly.

Mr. Clarke M. Rosecrantz, general counsel, Milwaukee Electric Railway & Light Company, discussed other elements of value than franchise values. Taking up first values that were neither physical nor franchise in nature, Mr. Rosecrantz said that as a result of the litigation construing the questions involved, common and equitable views as to what constitutes the value of the intangible property of public utilities were gradually being reached. Good-will as such will not be considered. Going value is made up of various elements—cost of promotion and deferred dividends when the question is one of reasonableness of rates, to which will be added a further sum for intangible values based upon the capitalization of the net earnings available for dividends. For municipal acquisition the same elements will be considered and the same rules followed as if the sale were between private parties. The valuation for taxation purposes approaches the exchange value. Mr. Rosecrantz said that in all valuations of physical value it may as well be recognized as an axiom that only the depreciation value will be considered, that is, the then value of the physical property. All efforts to have the basis fixed upon the cost of reproduction new have been unavailing and

the courts are ruling that the cost of reproduction new less depreciation is the test of determining physical value. It would then seem of the highest importance that definitions for determining accrued depreciation be agreed upon speedily and with fairness.

Mr. William M. Wherry, Jr., of Wherry & Mygatt, New York, discussed franchise values before the American Association. A franchise unused, he said, is of no value. A man who develops and uses it is performing services, and the value which accrues from such use and development is the measure of those services. The consideration for the development of the franchise is this value and it cannot be taken away without depriving those who have created it of the reward for their services.

Mr. Richard McCulloch, United Railways Company of St. Louis, discussed the present tendency of public service regulation before the American Association. He said that the conditions of operation without regulation and operation under regulation are quite different. The change has been sudden and it will require time for the utilities to adapt themselves to the new conditions as well as time for the commissions to become familiar with the immense amount of detail which they must handle before they can intelligently pass on the problems presented. Public service commissions may have been instrumental in putting an end to certain bad financial practices, but their growing disposition to interfere in the details of the business and their policy of cutting the rate of return to a barely non-confiscatory basis is not encouraging to investors. A far-seeing regulation would be one which would encourage the investment of private capital.

Mr. Frank Hedley, Interborough Rapid Transit Company of New York, read a paper on the "Present Tendency of Public Utility Laws and Regulations" before the American Association. He said that the existence of a public service commissioner with ample power to regulate is of great assistance in defeating demagogic bills introduced in the Legislature for political effect and violently opposed to corporation rights. By the adoption of a uniform system of accounts the field of railroad securities is made a safe and inviting one with resultant benefit to both the company and the public. When the personnel of commissions embraces men of practical experience, fairness of mind and education suited to the tasks confronting them (a discharge of duty without consideration for political expediency) Mr. Hedley thinks there will be that degree of co-operation and hand-in-hand work which is desirable for all.

A report of the committee on welfare of employees was presented before the American Association by Mr. J. J. Burleigh, Public Service Corporation of New Jersey. In the report it was said that if men are to be kept for long periods in a given service their employment must be made attractive and inducements must be offered beyond the prevailing day's wage. Moreover, if a man gives the best years of his life to an industry he has some right to expect that industry to provide for his sustenance when his days as a producer have passed. The Public Service Corporation of New Jersey, which assumes the entire cost of what it regards as four types of insurance, namely, health, accident, old age and life, finds that last year it expended for these purposes $104,818.

In a paper on "Statistical Units Used in Analysis of Electric Railway Accounts," presented before the Accountants' and the Transportation & Traffic Associations jointly, Mr. James A. Emery, with Ford, Bacon & Davis, New York, said it seemed the height of absurdity in the electric service business to draw careful distinctions between the elements of demand and output in making rates and then to pay absolutely no attention to this distinction in the records of cost of service. To determine or check the important figures upon which the charges to customers are based, it is necessary to go through a painful process of analyzing expense and construction accounts. There is no reason why central-station expense accounts, he argued, should not be kept in such a way that a company may know every month the cost of maintaining a kilowatt of equipment in readiness to serve, of the additional cost of generating and distributing 1 kw-hr., and of the cost per customer of those operating expenses which vary directly as the number of customers.

The subject of the income tax law was discussed at the meeting of the Accountants' Association. Mr. C. L. S. Tingley, American Railways Company, said that while he did not want to be reported as speaking authoritatively, he was advised that where a mortgage provided that the income should be paid without reduction for any present or future tax the company would be required to pay the tax.

The Engineering Association will publish an Engineering Manual containing the existing standards and recommended practices of the association. The association has compiled the recommendations governing standards of previous ocnventions and has them in such shape that it is expected that the 1913 additions can be inserted without serious delay and the complete manual made ready for distribution not later than Jan. 1, 1914.

In the discussion of the report of the committee on energy distribution before the Engineering Association, Mr. H. G. Stott, New York, suggested the addition of a paragraph to the following effect: "In awarding contracts based on these specifications, due regard should be given to the reputation of the manufacturer as an element to be considered."

Philadelphia A. I. E. E. Meeting

A regular meeting of the American Institute of Electrical Engineers was held at Philadelphia on Oct. 13, the headquarters and meeting hall being in the Drexel Institute. President C. O. Mailloux, who honored the gathering by his presence, insisted on leaving the conduct of the meeting in the hands of Mr. A. R. Cheyney, chairman of the Philadelphia Section of the A. I. E. E.

ELECTRIC DRIVE IN MACHINE SHOPS

The importance of the motor drive for the machine shop was well emphasized in a paper presented by Mr. Charles Fair, Schenectady, N. Y. The author stated that, on account of recent improvements in motors, accessories and methods of application, and the increase in the number and variety of motor-driven tools in service, the relationship of motors and control to machine tools is much better understood by the machine builder and the user than heretofore and, consequently, comparatively little trouble is experienced with either motors or control for the ordinary type of machine tool. Misapplications of both motor and control occur occasionally due largely to insufficient or unreliable information regarding the characteristics of the machine but the number of these misapplications is relatively small. The tendency to both over and under-motor machines is constantly growing less, owing to the large number of tests made, and to the accurate information available. There is still, however, a tendency on the part of some machine builders to over-motor their machines either with the mistaken idea of the strength of their machine or with the idea that possibly prospective customers will be impressed with the enormous power that their "heavy type" machines take. Conversely, other manufacturers want to show how little power it takes to operate their "very efficient" machines and consequently get into trouble. These extremes are gradually disappearing and a more normal condition is taking its place. In a comparatively short time the greatly over-motored and under-motored machine will be a thing of the past, at least so far as the general type of machine is concerned. A number of manufacturers have already recognized three ratings of motor drive on certain of their machines, namely, heavy, medium and light. Much of the existing

trouble in motor applications to special machines or to machines rigged for special operations could easily be avoided if only preliminary tests were made with a temporary motor before making the permanent installation. A not uncommon source of trouble, and one that could easily be avoided, is that of attempting to increase considerably the productiveness of a tool by speeding up the machine, increasing the cuts and attaching automatic feeding devices, etc.; all of which increases production, but, in doing so, the motor is often overlooked and, if the tool were originally under-motored and the power is not increased, trouble is apt to result. Increased production often calls for an increase in power although there are cases where this is not true.

To increase production and to decrease cost are two important questions continually before the manufacturer to-day. In the majority of cases labor is the greatest cost of production, thus where machine tools are a considerable factor in the production, the importance of obtaining maximum output from the tool is evident.

Mr. Fair remarked that the improvements in control appliances have kept pace with the motor development. Much more exacting requirements of both motor and control are now demanded. Motors driving machines reversing ten times per minute, twenty-four hours per day, are now not uncommon. Duty cycles that were impossible to meet only a short time ago are now not only practicable but common.

Much of the success of a motor-driven machine depends on its control. Magnetic control, which is coming into more general use than formerly, somewhat complicates the control situation. While the possibilities of magnetic control are infinitely greater than the older types of control, likewise the chances for misapplication are greater. However, as the characteristics of the different types of control become better known these complications will disappear.

Discussion

Mr. Harold Goodwin, Philadelphia, expressed the opinion that in making a selection between individual motor-drive in machine shops and group drive the determining feature is often the cost. Although from many points of view individual drive is preferable to group drive, yet the extra cost involved in driving each machine individually over that required for group drive is prohibitive.

Prof. A. J. Rowland, Philadelphia, called attention to the importance of considering the depreciation of equipment when discussing the relative merits of group drive and individual drive.

Mr. R. L. Lloyd, Philadelphia, stated that one must take into consideration the importance of economy of operation with individual drive in comparison with the interest on the initial expenditure for the individual drive equipment.

Mr. C. O. Mailloux, New York, said that the belt had practically disappeared from industrial establishments in Europe, motor drive having been substituted for line-shaft drive in European practice. This fact can be accepted as conclusive evidence against any argument as to the excessive cost of electrical motor drive, because in Europe every increase in expense for equipment is investigated thoroughly before the equipment is purchased. In textile mills motor drive is now used exclusively not only on account of the economies in operation but by reason of the increased production and uniformity of output.

In closing the discussion, Mr. Fair remarked that under ideal conditions it would be best to use both individual drive and group drive, and perhaps both alternating-current and direct-current motors. In some cases the major number of machines will be driven in groups, and in other cases individual drive will predominate. In each case the cost for the motor equipment would be more than covered by the increase in production.

INDUSTRIAL SUBSTATIONS

Many of the important features of design and installation of industrial substations were discussed in a paper by Mr. H. P. Liversidge, Philadelphia. Descriptions were given of twelve plants of this nature selected as being representative of good modern practice.

In analyzing the design details special attention was paid by the author to space economy, cost, operating requirements, fire hazard and safety to attendants. The author stated that space economy must be given careful consideration, especially when the equipment is to be installed in an already existing factory building, where the consumer has allotted all the space available, and this space permits no latitude in the arrangement of equipment.

A striking example of economy effected was afforded by a synchronous converter substation of four 300-kw units. The space provided for the equipment was one corner of an existing engine room which already contained several engine-driven generators, a heavy duty air compressor, and other miscellaneous power plant auxiliaries. The floor area allotted to the substation equipment measures approximately 30 ft. by 30 ft. The height of the engine room permitted the construction of a short gallery upon which was placed all high-tension switching and protective apparatus. This arrangement, while it might not have been selected had a new substation building been erected, nevertheless made possible the installation of all apparatus without necessitating any changes in the building construction.

The author said that the conditions under which the various equipments of substations operate are often radically different, due to the requirements of the consumer, and that careful consideration should be given this point.

One of the important features relating directly to the operating requirements is the duration of continuous service, which may vary from a few hours per day to a practically continuous supply. As due provision must be made for inspection and repairs, it is quite evident that, in the case of continuous operation, attention must be given to the proper sectionalization of the apparatus and duplication of equipment. In this case of a certain plant described by the author each individual circuit controlling the incoming feeders and transformer banks is provided with disconnecting switches. This plant operates almost continuously, and such an arrangement permits of a ready examination of the operating equipment during light loads, without necessitating the interruption of the consumer's service. This type of construction also permits a comparatively simple installation, and obviates the necessity of a duplicate set of busbars and oil-break switch equipment.

In contradistinction to this arrangement a second plant supplying energy for very intermittent service is arranged without any means for sectionalization. Provision is made merely for disconnecting the single incoming high-voltage feeder from the substation equipment.

Concerning fire hazard and safety to attendants attention was called to the tendency toward particular care in construction details as they relate directly to this subject. Where substation apparatus is to be installed in existing industrial plants, a considerable amount of reconstruction is sometimes advisable. In many cases, the floors and ceilings of the industrial buildings are of wood. These should be made fireproof. The usual building alterations consist of the changing to concrete flooring and metal-lined or asbestos-covered ceilings.

In oil-cooled transformer installations, special arrangements are necessary for properly draining the contained oil from the transformer cases. This is accomplished either by pipes connected directly to the transformers or by concrete drains built in the transformer foundations and connected to a common outlet.

An interesting example of this latter type of construction was noted in one installation in which the transformer banks were placed on a concrete base so constructed as to

provide a very effectual drainage system for the entire equipment. The high-voltage switchboard equipment was enclosed to secure the maximum of safety to attendants. Asbestos lumber doors and partitions form the more important part of this detail in construction. Besides serving as a protection from accidental contact with high-voltage circuits, these partitions in many cases are excellent barriers for protection from fire.

Concerning cost the author stated that not infrequently the central station engineer is limited to a certain minimum expenditure imposed by the prospective consumer, and which in most cases affects the electrical equipment under consideration. It is evident that this limitation may affect materially the character of the installation; and particularly will this be evidenced in the switchboard and controlling equipment. The changes in this part of the construction are most apparent in the details of control equipment, namely, the type of switchboard, whether marble, slate or open iron frame; the number and type of instruments on the individual circuits, and the character of bus-bar construction. These details in many cases are closely related to, and influenced by, the factors already noted. Nevertheless, there are many points in the design that will be directly influenced by the important question of construction cost.

Discussion

Mr. W. C. L. Eglin, Philadelphia, claimed that the author had placed too much importance upon minimizing the space occupied by substation equipment. In many cases the cost of space is small compared with the reliability of service. In the substations described sufficiently free space was provided around the revolving machinery, but the stationary apparatus was crowded together to a degree not warranted by the advantages obtained thereby. Although certain advantages are secured by enclosing switches and other electrical devices it seems best to make enclosure in such a way as to render a considerable portion of the equipment visible for rapid inspection in case trouble develops. Mr. Eglin remarked that instead of employing extreme measures to prevent water from entering substations it would often prove advantageous to select waterproof apparatus which cannot be injured by complete submersion.

Mr. P. M. Lincoln, Pittsburgh, expressed the opinion that under present conditions a correct design of an industrial substation is as important as the design of the main generating station in many communities.

Mr. G. W. Brooks, Philadelphia, remarked that in three-phase installations it does not seem desirable to provide complete duplicate sets of transformers because the desired results can be obtained by installing as reserve one single-phase transformer rather than three transformers connected as a three-phase group.

In closing the discussion Mr. Liversidge called attention to the fact that the space allotted to industrial substations is most frequently determined by the owner of the industrial establishment who sets aside for this purpose the minimum amount of space in which the apparatus can be placed. In reply to questions by Messrs. Charles Penrose and Harold Goodwin, Philadelphia, Mr. Liversidge stated that the amount of equipment which should be installed for insuring continuity of service, such as double bus-bars or sectionalized bus-bars, is determined by the character of service to be rendered. If the equipment is to be operated continuously and no time is allowed for periodical inspection duplicate apparatus must be available, but if the service is such that the equipment can frequently be inspected and is idle at regular intervals such added expense is often not justified. He claimed that with modern apparatus properly installed and operated central-station service could be guaranteed to be absolutely reliable so far as continuity is concerned.

VARIATION OF ENERGY COST WITH PLANT SIZE

In a paper presented by Mr. Paul M. Lincoln, Pittsburgh, Pa., three reasons were assigned for substituting central-station for isolated-plant service. These reasons are:

1. Because the first cost per kilowatt of large units entering into the construction of a large plant is lower than that of the small units entering into the construction of a small plant, thereby reducing the first cost of the apparatus necessary for the given service and, therefore, reducing the annual fixed charges thereon.

2. Because a large plant inherently can be operated more economically than a small one, and because, further, the large plant can afford to introduce economies which would be out of the question in a small one.

3. Because of the existence of diversity-factor, whereby 1 kw of equipment rating in a central station will serve a combined load that would take considerably more than 1 kw if each part of that combined load were to be served separately.

Mr. Lincoln stated that there are two arguments that may, with reason, be urged against the central station method of supply. The first is that the central station requires the addition of a transmitting and distributing system before its customers can be supplied and the cost, upkeep and losses in this transmitting and distributing system must be added to the central station to make it comparable with individual customers' plants. This argument is entirely legitimate, as far as it goes, but it does not go far enough. The cost and losses of the transmitting and distributing system do not amount to enough to begin to offset the advantages on the part of the central station. It is, of course, possible to imagine a condition where the cost and losses of transmission and distribution make the central station supply more expensive than that from an isolated plant, but this means that the proper radius of the station has been exceeded. The advantages (in the matter of cost) of the central stations are so great that the utmost additions on account of transmission and distribution, and still maintain good regulation, are not sufficient to permit isolated plants to compete.

The second argument in favor of the isolated plant is that during the season that heating is required the steam may be used twice, as live steam for energy generation and as exhaust for heating. This is also a legitimate argument so far as it goes and its complete discussion requires much space. In general, however, it can be shown that the advantages which accrue to the centralization of a large amount of power at one point will far outweigh the advantage of the isolated plant even when it is coupled with the heating proposition, as it so often is.

When the isolated plant is used for heating, one must bear in mind that there is a large part of the year, certainly more than one-half of it, when no heating whatever is required and during this period the plant must accept the losses which are inherent with the combination of energy generating and steam-heating plant using the same steam. Another thing which must not be forgotten is the daily diversity between the heat and electricity loads in the isolated plant. Take for example, the case of an office building. The building will, of course, cool off to a certain extent during the night and it is required that it be brought to a certain acceptable temperature by the time the office force arrives in the morning. This will require a considerable amount of steam during the early morning hours at which period absolutely no use is made of energy for lighting in the building and practically none for motor service. The heavy demand for energy in this same office building will occur just before the force is getting ready to leave for the night and at this particular period of the day the requirements for heat are at a minimum because the heat inertia of the building is sufficient to keep up the temperature at this time, and it is useless to put in more

heat at the time when the force is getting ready to leave. Therefore, while it is perfectly true that the same steam can be used economically for lighting and heating, it is impossible so to arrange a combination plant of this kind that the diversity in time requirements for the different kinds of service render it possible to make complete use of this advantage. This is a case where diversity works against and not for economy.

As a result of the foregoing analysis, Mr. Lincoln expressed the opinion that there are only two reasons why central stations do not supply all of the electric service within legitimate reach of their distributing systems. These are, first, because the rate offered by the central station does not bear a suitable relation to the cost of the service to be supplied, and, second, because the prospective customer has some motive other than the cost of the supply for not taking his service from the central station.

Discussion

Mr. H. A. Hornor, Philadelphia, claimed that in making estimates concerning the cost of service rendered by isolated plants, central-station managers obtain figures that are too high, while the isolated-plant engineers give figures that are too low. He expressed the opinion that when the facts are properly presented to isolated-plant owners by central-station managers the number of isolated plants in central-station territories will rapidly become smaller.

Mr. W. C. L. Eglin, Philadelphia, remarked that the economy of isolated-plant equipment rapidly becomes less when used, yet it is difficult to convince isolated-plant owners of this fact. Although little difficulty is experienced in convincing a factory owner that it is not to his advantage to install an isolated plant initially, yet it is very hard to convince the owner of a plant now in service that it is to his advantage to scrap his plant equipment and purchase energy from a central station.

Mr. C. O. Mailloux, New York, called attention to several cases where isolated-plant service was found to be much more economical than central-station service. One of there was a large sugar-refining establishment, in which 10,000 hp was needed for evaporation processes. In this case the steam was produced at a pressure of 150 lb. and utilized at 10 lb. after having passed through steam engines used to drive electric generators. In this way the electrical energy became an extremely inexpensive by-product. A large portion of this energy is being used for electric cooking, from fifty to 100 people being served in this manner. Mr. Mailloux predicted that the development of high-efficiency tungsten lamps will have the effect of decreasing the number of isolated plants, because when such lamps are used the cost of central-station service is relatively small compared with the cost of operating an isolated plant.

Dr. M. G. Lloyd, Chicago, stated that in comparing isolated plant with central-station service, it is not proper to ignore the high cost of the system for distributing energy from the central station. In many cases the cost of the distributing circuits and equipment is equally as great as that of the generating plant. Although the peaks of the lighting load and of the steam-heating load do not occur simultaneously, yet it is improper to state that the steam may be cut off from office buildings late in the afternoon. The fact of the matter is that office buildings must be kept well heated each night until, say, 10 o'clock, because a few of the tenants remain in their offices until this hour or later.

Prof. J. P. Jackson, Harrisburg, remarked that isolated-plant owners are usually unwilling to acknowledge that obsolescence has any effect on the relative economy of operating their equipments and purchasing central-station energy. On this account central-station managers often experience difficulty in convincing isolated-plant owners of the economies involved in substituting central-station service for isolated-plant service.

Kansas Convention at Hutchinson

The sixteenth annual convention of the Kansas Gas, Water, Electric Light and Street Railway Association was held at Hutchinson, Kan., Oct. 9 to 11, with an attendance of over 100 members and guests. Mayor Frontron welcomed the convention to Hutchinson, and Mr. B. F. Eyer, of Manhattan, responded on behalf of the association. In his official address President L. O. Ripley, of Wichita, discussed matters of association organization, and the subject of affiliation with the N. E. L. A. The executive committee has advised against this step, owing to the fact that the Kansas association includes other than electric utilities. It has recommended, also, that the name be changed to that of the Kansas Public Service Association.

ILLUMINATION TOPICS

Mr. F. A. Pielsticker, of Eldorado, opened the technical program with an interesting paper describing an ornamental street-lighting system recently installed in his city at moderate cost. An abstract of this paper will be given later in these columns. Mr. C. L. Bullock, Wichita, followed with a paper on natural-gas transmission.

Mr. G. R. Walker, St. Louis, Mo. characterized the development of the new nitrogen-filled lamp as an important step in the progress of illumination. He also explained how burning ordinary lamps below rating reduces central-station revenue. Several methods of avoiding such losses were suggested, among them being that of dividing a city into voltage zones. All service wires in one zone would then supply a definite voltage, for which the lamps used in that zone would be especially designed. The nitrogen-filled lamp was also described further by Mr. F. T. Benson, Chicago, who enumerated its advantages.

Following Mr. Benson's talk the session adjourned and the members boarded trolley cars for a sight-seeing trip. In the evening a smoker was held in the club rooms, at which Mr. P. Lloyd Lewis, of Kansas City, Mo., explained the purposes of the Jovian Order.

Mr. F. B. Uhrig, Kansas City, Mo., read a paper on "The Treatment of Poles," which he illustrated with stereoptican views. He spoke of the increasing demand for poles, the limited supply available, and the resulting necessity for preserving those now being set. The suitability of Michigan and Western cedars for different conditions was brought out, and the theory and methods of preserving timber against decay were discussed. Results obtained from tests on treated and untreated poles, as well as on poles whose butts have been reinforced with a collar of concrete, were also described. Mr. Uhrig closed his remarks by enumerating some of the advantages of concrete poles.

IRRIGATION WITH MOTOR-DRIVEN PUMPS

Artificial irrigation in western Kansas is practical and will be effective in increasing the production of grain in the state, declared Mr. H. B. Walker, state irrigation engineer, at Friday morning's session. The annual precipitation in western Kansas is about 20 in., which is insufficient. An enormous underflow of water, however, exists beneath the state at depths varying from 60 ft. to 300 ft. There are two and three separate basins in some localities, and the supply does not seem to be affected when drawn upon by individual pumping plants. For suitable irrigation at least 10 gal. of water per minute per acre should be available. Mr. Walker therefore advises drilling batteries of wells, each 10 in. to 15 in. in diameter and 30 ft. from center to center, connecting a common suction from one pump onto such a group. For lifts of over 30 ft. it is necessary to sink a well casing and install pumps at the bottom. With electrically driven centrifugal pumps water can be delivered to irrigation ditches at from 3 cents to 9 cents per acre per foot of lift. Single-stage pumps are preferable for lifts of 50 ft. or less, while multi-stage pumps are desirable for the higher lifts.

Most of the dissatisfaction experienced with artificial irrigation can be traced to ignorance on the part of the operators of pumping engines. When driving centrifugal pumps such engines must be operated at a definite speed. Mr. Walker believes that electrically driven pumps using central-station energy furnish the best solution for the irrigation problem.

During the discussion Mr. Ripley described a large electric pumping plant being installed on a farm near Wichita. The electric-service company there paid for the 35-hp motor and the pumps, and the farmer will run the plant to give a practical demonstration of the usefulness of such an installation. Data obtained from this equipment will be used in fixing rates for future service to other farm customers.

Mr. E. E. Wakefield, of Chicago, delivered an interesting paper on "Fire Insurance," quoting figures to show that the United States pays more for its fire losses than all other countries put together. Too often fires which cannot be traced to other causes are attributed to faulty wiring. Mr. Wakefield closed his remarks by describing the layout of a central station ideal from the viewpoint of fire prevention.

"The Manufacture and Installation of Concrete Poles" was the title of a paper by Mr. C. L. Brown, of Abilene. The author, who is a central-station man, has devoted considerable effort to developing and improving a hollow reinforced-concrete pole to take the place of cedar poles for overhead transmission work. An abstract of his paper will appear later in these columns.

DISTRICT HEATING AND UTILITY OPERATION

"Central-Station Heating in the Smaller Cities" was the subject discussed by Mr. H. C. Kimbrough, of Chicago. Specific examples were given showing the efficiency of district heating when the mains are properly insulated, and typical engineering problems were discussed to indicate the amount which can be legitimately expended to improve a system. The heating plant of the Excelsior Springs (Mo.) Water, Gas & Electric Company was described, and forms of contracts for heating were reproduced.

Mr. A. M. Patten, of Topeka, followed with a description of the district-heating system in his own city, where several hotels, a number of business buildings and the Santa Fé Railroad shops are served with steam heat. The fact that the company is equipped to furnish both steam heat and electricity is of value in keeping out isolated plants.

"Some General Features which All Public Utilities Have in Common" was the subject on which Mr. Patten was scheduled to make an address. His paper was short but to the point, bringing out some interesting features. Better understanding between utilities and public he cited as a most important requirement for successful operation. If only the utility which occasioned public enmity were affected, the results might not be so disastrous, but the sentiment once developed is generally directed at all corporations, guilty or innocent. Employees should be taught the company's policies and should be informed that it is, after all, the public which pays their salaries. Utilities should keep in touch with the people through the newspapers. It is better that news should originate from the right source in the first place; and cordial newspaper relations are advised even if the information divulged is unsatisfactory in character. Good service is, of course, essential in all cases.

In the discussion which followed this paper Messrs. L. O. Ripley, W. E. Sweezy, Junction City, Kan.; H. R. Summerhayes, of Schenectady, N. Y.; Louis Bendit, Kansas City, Mo., and C. L. Brown, Abilene, Kan., took part. Much of this discussion grew out of reports that consulting engineers have advised cities to operate their own plants and furnish service at lower rates than is possible if expenses are to be paid. The engineers' opinions were formed in many of these cases without having investigated all the conditions, it was contended, but such reports are nevertheless harmful in producing dissatisfaction with existing conditions.

The executive committee was advised to correct such fallacious views, and it was also suggested that operating data covering private and municipal plants would be valuable for comparison in checking. The opinion generally expressed was that the state commission should have jurisdiction over municipal as well as privately owned plants, and that at the next meeting of the Legislature steps should be taken to amend the utility law in this direction. In closing the discussion President Ripley declared that the commission should protect the investor as well as the public, and should not allow confiscation of property or misrepresentation of facts.

ELECTRICAL INSTALLATIONS

Mr. H. R. Summerhayes, of Schenectady, N. Y., next abstracted his general résumé on recent developments and tendencies in electrical apparatus, mentioning briefly such topics as the use of temperature-measuring coils in generators and transformers, design of large generators and transformers with high internal reactance, competition of Diesel engines with small turbines, development of nitrogen-filled tungsten lamps, etc.

Mr. C. A. Fees, engineer with the Kansas City Gas & Electric Company, Wichita, read a paper entitled "Determining Operating Costs of Power Installations," which gave a synopsis of methods of ascertaining costs of operation when energy is generated or purchased. An engineering study of the layout of a plant in advance will simplify such classification of expenses. Considerable insight into operating problems may be secured by interviewing employees. Through conversations with engineers of isolated plants subjects are often also brought up which show the advantages of central-station energy. The speaker described methods of selecting types of motor drive (whether individual or group) for use in factories. Methods of estimating the power required, and the load factor obtained under different arrangements were also discussed.

Messrs. W. E. Sweezy, Junction City, and W. A. Scothorn, Wichita, took part in the discussion on energy consumption required for milling grains under different weather conditions. Mr. Scothorn said that in a 80-barrel to 120-barrel establishment 3.5 kw-hr. to 7 kw-hr. is required per barrel of grain milled. Mr. Fee gave from 6 kw-hr. to 7 kw-hr. per barrel as the range in consumption.

EDUCATION AND UTILITY VALUATION

Dean P. F. Walker of the engineering school of Kansas University, Lawrence, described the latter's correspondence course arranged for the education of central-station employees. The course will be inexpensive and will be similar to that inaugurated by the University of Wisconsin. Work of a practical nature is being mapped out for boiler and engine-room employees. Dean Walker solicits suggestions from central-station managers and superintendents. President Ripley and others joined in hearty recommendations of the work, and promised their cooperation.

Prof. George Shaad, of Kansas University, Lawrence, read an interesting paper on "Intangible Values and Their Relation to the Valuation of Public Utilities." Subjects of valuation, determination of rates, franchises, and goodwill were discussed. The speaker favored putting state commissions in control of municipally owned utilities. Rates should be fixed according to cost of production, and should represent a reasonable return on physical value plus intangible value. In states where commissions prevent unnecessary competition, franchises and good-will have no capital value, the speaker asserted. "Going value" can be estimated by logical methods and Professor Shaad believes

should be capitalized along with early losses in operation.

A discussion followed regarding capitalization of discounts on bond issues, in which Messrs. Sweezy, Ripley and H. W. Magruder, Liberal, took part. A diversity of opinion was brought out, the contention being whether the discount should be charged to capital account, operating expenses, or profit and loss.

INTERNAL-COMBUSTION ENGINES

A paper was read at the evening session by Mr. F. L. Weakly, Kansas City, Mo., on the "Internal-Combustion Engine." The speaker said that oil engines give a more uniform turning moment than gas engines, and are hence better suited to driving generators. Although the price of gasoline is continually rising, Mr. Weakly believes that crude oil will be subject to the same changes in price as coal. Crude-oil engines of moderate size should operate at a cost of 1.25 mills per brake hp-hour at full load, and maintenance should not exceed 60 cents per 1000 hp-hours. A table was shown comparing the cost of power from crude oils, fuel oil, and distillates.

Mr. Louis Bendit, Kansas City, Mo., followed with a brief talk on the same subject. Oil engines, he suggested, can be installed by central stations in isolated districts to educate the people of the locality to the advantages of

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electric service. Then after a load has been built up, transmission lines can be erected to connect the central station with the new community, the oil-engine set being meanwhile installed to develop another locality.

FINANCING OF PUBLIC UTILITIES

In the absence of Mr. H. P. Wright, Kansas City, Mo., his paper on "Financing of Public Utilities" was read by President Ripley. Obligations and fixed charges should be so arranged that they may be settled from surplus earnings, declared the author. The conditions contained in franchises should be satisfactory to begin with, for they can seldom be changed after acceptance. Bond issues should not exceed 50 per cent of the value of the property, Mr. Wright believes. Stock should be controlled by the common stockholders, and the preferred stock issue should represent only half the common stock. Modern equipment should be installed, and stockholders should be informed periodically of the physical condition of the plant and the local political situation.

Mr. Charles D. Bell, of Wichita, Kan., delivered the last paper on the program, which was entitled "Some Features in the Organization and Development of an Interurban Railroad." He said that interurban freight traffic can be considerably increased when there is an interchange of cars with steam roads. Most of the freight of an interurban line can be carried during the night after regular passenger traffic has ceased, utilizing off-peak hours of plant operation. Other subjects touched upon were those of handling and estimating traffic, construction features, equipment, attitude of the public, and treatment of employees.

NEW OFFICERS AND NEXT MEETING PLACE

On Friday evening, Mr. M. T. Flynn, Kansas City, Kan., chairman of the nominating committee, submitted recommendations for new officers. These were accepted by vote of the association and the election announced as follows: President, Mr. A. L. Newman, Arkansas City; first vice-president, Mr. H. W. Magruder, Liberal; secretary-treasurer, Mr. Ivor Thomas, Wichita; chairman of the executive committee, Mr. L. O. Ripley, Wichita.

Mr. Newman, the president-elect of the Kansas association, is the secretary-treasurer and manager of the Arkansas City (Kan.) Gas & Electric Light Company, with which he has been connected since 1905.

The 1914 meeting of the association will be held at Arkansas City, Kan., some time in October.

During the Hutchinson convention Messrs. J. F. Springfield and W. A. Scothorn entertained the delegates with trolley car and railroad trips to points of interest about the city.

Public Service Commission News

MASSACHUSETTS COMMISSION

The Public Service Commission has issued a finding approving by a vote of 4 to 1 the petition of the New York, New Haven & Hartford Railroad for authority to issue 6 per cent convertible debenture bonds at part to the amount of $67,552,000, to meet the cost of improvements and retire floating indebtedness. The decision involves an interpretation by the board of the financial sections of the 1913 public service commission act, and follows protracted and heated hearings. The board finds that the company's floating debt and prospective equipment funding are necessary and proper; that the commission has authority to permit the issue of bonds convertible into stock at par, although such action has never before been taken in Massachusetts; that the 6 per cent rate of interest is proper and necessary in the present market conditions; that the capital stock of the company is sufficient to warrant the issue under the act of 1913, and that if the company were required to issue short-time notes to meet its financial needs, the cost would be excessive and the remedy but temporary. The proposed 2½ per cent underwriting commission for the Morgan banking house is condemned as not in accord with ethical standards or sound public policy, in view of the directoral relations existing. Commissioner George W. Anderson filed a dissenting report. It is understood that some of the funds raised on the issue will be applied to electrification work on the New Haven system.

OHIO COMMISSION

The Public Utilities Commission, realizing that the bond market is not in such condition as to enable a company to sell its securities advantageously, has granted the Valley Light & Power Company of Maumee authority to borrow money on its issue of $49,000 first-mortgage bonds. A condition is made to the effect that the amount borrowed must not be less than 80 per cent of the face value of the bonds.

The Ohio Fuel & Supply Company has been given authority to absorb the Cambridge Light & Fuel Company by purchasing the remainder of the stock from individual stockholders at $45,000. The stock's par value is $25,000.

Current News Notes

Passenger Cars, Not Pleasure Cars.—At the suggestion of Mr. George Harvey Jones, former chairman, the Chicago Section of the Electric Vehicle Association is endeavoring, so far as its influence extends, to use the term electric "passenger" cars rather than electric "pleasure" cars.

* * *

Electric-Service Plant at Nome Destroyed.—A great storm, beating in from Bering Sea, laid waste a large portion of Nome, Alaska, on Oct. 5 and 6. It is said that one-half of the little city has been destroyed, the damage being estimated at $1,000,000. Among other losses, the electric-light plant is reported as wrecked. This is probably the generating station of the Seward Peninsula Power Company.

* * *

Ice Plants Almost as Numerous as Central Stations.—Mr. Van der Vaart in reviewing the growth of the refrigerating industry before the International Congress of Refrigeration at Chicago recently said that there are about 3500 ice-manufacturing plants in the United States, equipped with machinery capable of producing between 18,000,000 tons and 20,000,000 tons of ice annually. The capital invested in the ice-making industry alone he estimated to be not less than $150,000,000.

* * *

Electricity on a Georgia Farm.—A Georgia farmer whose pasture is skirted by the high-tension line of a transmission company recently had a couple of fine cattle struck by lightning during a severe thunderstorm. Without delay he brought suit against the power company. When the latter's surprised attorneys questioned the plaintiff concerning grounds for his attack, he gravely explained that he had lived there "twenty years" and yet never until the erection of the electric wires had lightning ever struck those cows. Therefore he concluded to hold the electric company responsible.

* * *

Wireless Aids Banana Trade.—The proposed imposition of a tax on the importation of bananas has served to draw attention to the remarkable organization of the business of transporting bananas. The fruit is packed while green and rushed thousands of miles in a few days before it ripens. So carefully is this business of transportation organized that millions of bananas are brought from the tropics and sold so cheaply as to be within reach of all. As a precaution against loss due to the ripening of the fruit because of a delay in transportation, every fruit vessel is equipped with a wireless plant. If a fruit vessel be delayed, a wireless call is quickly sent out for help and assistance is rushed to the disabled vessel, so that the shipment is expedited in every way.

* * *

Labor Law in New York.—Attorney-General Carmody of New York State has rendered an opinion on the new labor law which became effective on Oct. 1, providing for one day of rest for employees of factories and mercantile establishments. The opinion was rendered in answer to a letter from Mr. William C. Rogers, Acting Commissioner of Labor, who said that he was in doubt as to whether the law should be applied to engineers and firemen in waterworks pumping stations and to engineers, firemen and other employees in private and municipal gas and electric light manufactories. The opinion of the Attorney-General is that engineers, firemen and other employees and private gas and electric manufactories come within the meaning of the act except as they are particularly excluded therein. He believes that an electric light corporation comes within the definition of a factory and that municipal gas and electric light plants are included within the law.

Trenching Through Stone with Wires and Abrasive.—To accommodate electric-power cables which will cross the River Seine on the 300-year-old Pont Neuf, Paris, a trench 4 ft. wide and 7.5 ft. deep is being cut through the solid masonry and flint-rock concrete of the bridge structure with the aid of helicordial wires and abrasive powder. The section trenched in this way, 550 ft. in length, was found to be too hard to be attacked by tools, while explosives were excluded for fear of weakening the venerable arches. Four parallel wire cuts were made in each of the three sections, each roughly 200 ft. in length. An 18-hp motor operated the continuous-belt cutting wires, which were held taut by weights, while abrasive powder was fed into the kerfs.

* * *

SOCIETY MEETINGS

Dallas Electrical Display.—Oct. 31 will be known as "Jovian and Electrical Men's Day" at the Dallas (Tex.) State Fair. Arrangements have been made for an electrical street parade at night when the residences and along the route will be kept in darkness to heighten the effect of the electrical illumination provided by the floats.

* * *

New England Wireless Society.—Interest in wireless telegraphy has been stimulated in New England by the recent alliance of the wireless societies of Tufts College, Harvard University and the Massachusetts Institute of Technology with the original body, the New England Wireless Society. Mr. Harold B. Richmond, 12 George Street, Medford, Mass., is secretary of the allied societies.

* * *

Welfare Efficiency Convention.—The Pennsylvania Industrial Welfare and Efficiency Convention will be held at Harrisburg, Oct. 28, 29 and 30, under the auspices of the Engineers' Society of Pennsylvania. The conference has been called by Prof. John Price Jackson, formerly dean of the School of Engineering of Pennsylvania State College, the recently appointed commissioner of labor and industry of the State of Pennsylvania. Representatives of industrial establishments, engineers, contractors and other employers of labor and heads of the various state departments coming in contact with engineering and industrial affairs will take part in the convention. An exhibition will be held in connection with the convention from Oct. 27 to Oct. 31 in the building of the Harrisburg Railways Company. A program of papers covering a wide range of subjects has been arranged. The meetings are to be held at the State Capitol. Mr. George S. Comstock, president of the Engineers' Society of Pennsylvania, will preside at the convention.

* * *

New York I. E. S.—At a meeting of the New York Section of the Illuminating Engineering Society held on Oct. 9, Mr. Norman Macbeth reported his observations of the recent Pittsburgh convention of the society, giving a brief outline of the main convention features and abstracts of the papers and discussions. Mr. A. L. Powell presented the paper, of which he and Mr. Clarence L. Law were the authors, entitled "Distinctive Store Lighting." This paper was illustrated with lantern slides and auto-chrome color plates. It was discussed by Messrs. G. A. Stickney, V. R. Lansingh and J. B. Taylor with special reference to the use of colored lantern slides. The next meeting of the section will be held jointly with the New York Section of the National Electric Light Association, in the Edison Auditorium, Twenty-seventh Street, on Nov. 17. The neon-tube lamp will be demonstrated and discussed. Street lighting abroad will be discussed at the December meeting, which will be held in co-operation with the Municipal Arts Society.

The "1912 Extension" to Fisk Street Station

Very large turbo-generators, including one 25,000-kw. unit imported from England—Some details of the latest example of power-house design in Chicago

UNUSUAL interest attaches to the "1912 Extension," as it is called of the Fisk Street generating station of the Commonwealth Edison Company of Chicago. Work on this extension has been delayed for various causes, and is still under way, although it was on March 23, 1912, that the *Electrical World* contained the announcement that the company had placed an order with Messrs. C. A. Parsons & Company, Ltd., Newcastle-on-Tyne, England, for a 25,000-kw horizontal turbo-generator to be erected in an extension to the widely known Fisk Street generating station. Later a 20,000-kw horizontal turbo-generator was ordered from the General Electric Company of this country for the same addition to the generating station. The parts of the English unit have been delivered in Chicago, being imported in bond to the point of destination.

The Fisk Street extension possesses a great degree of interest, partly from the large side of the units employed (although a 30,000-kw horizontal General Electric unit has been ordered more recently for the Northwest station of the Commonwealth Edison Company), partly from the fact that it marks a departure from the vertical steam-turbine units previously installed by this company, partly from the ingenious and compact arrangement of the steam-raising equipment, and partly from the international character of the undertaking. The English unit was designed and built under the personal supervision of Sir Charles A. Parsons, perhaps the leading authority on steam-turbine engineering; the English consulting engineers for the work are Messrs. Merz & McLellan, of Newcastle-on-Tyne and London, while the American consulting engineers of the Commonwealth Edison Company, Messrs. Sargent & Lundy, of Chicago, have the immediate responsibility for the execution of the work, having, in conjunction with the electrical engineers of the company, designed all of the company's generating stations.

GENERAL FEATURES

Extending from the south end of the existing station, which has a service rating of 120,000 kw, the addition under construction extends for a distance of 200 ft. to the South Branch of the Chicago River. The width of the extension is about 265 ft., while the older portion of the building is 240 ft. wide. The entire station, when completed, will be about 675 ft. long and will be a harmonious and imposing architectural unit. The switch-house is being extended also to correspond to the generating-station requirements.

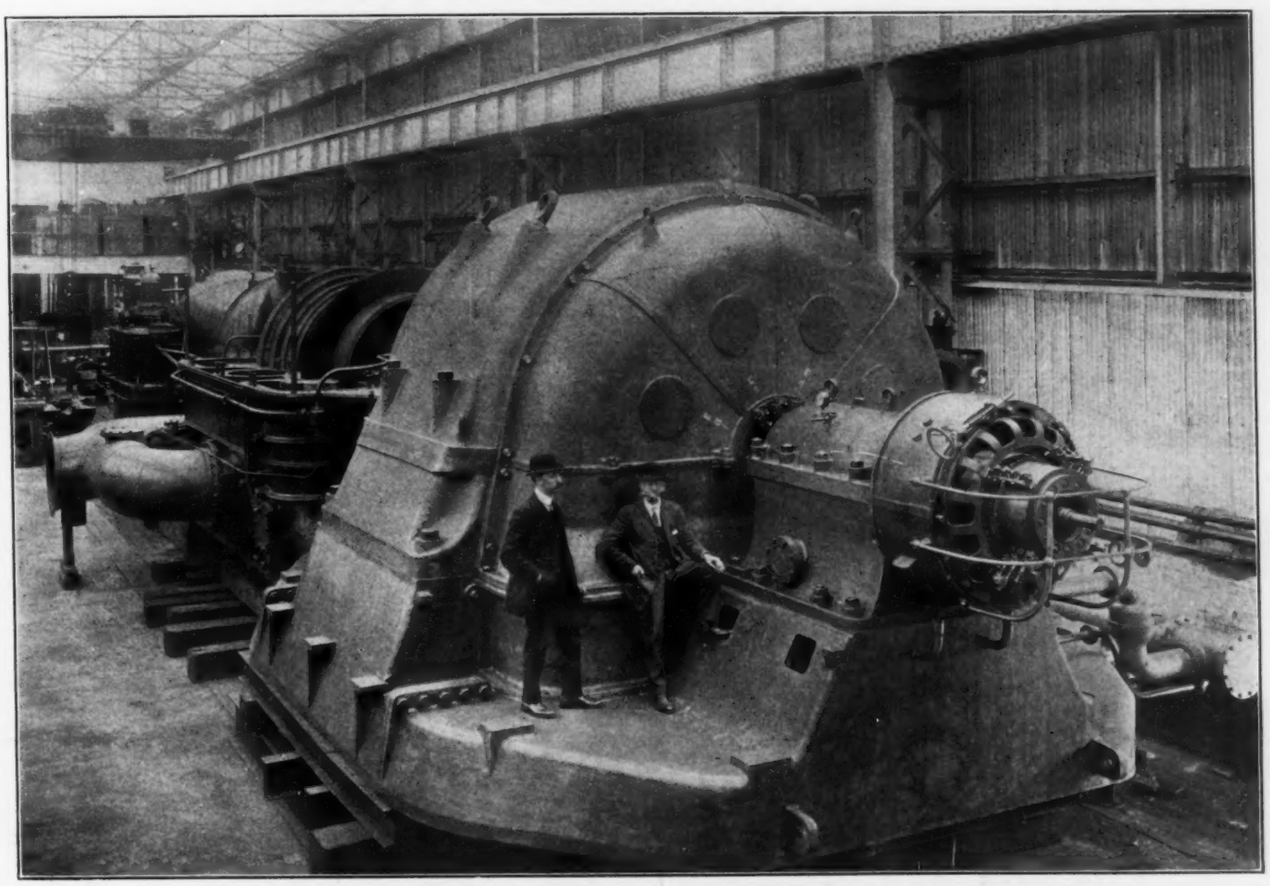


FIG. 1—GENERATOR END OF 25,000-KW ENGLISH UNIT FOR COMMONWEALTH EDISON COMPANY OF CHICAGO

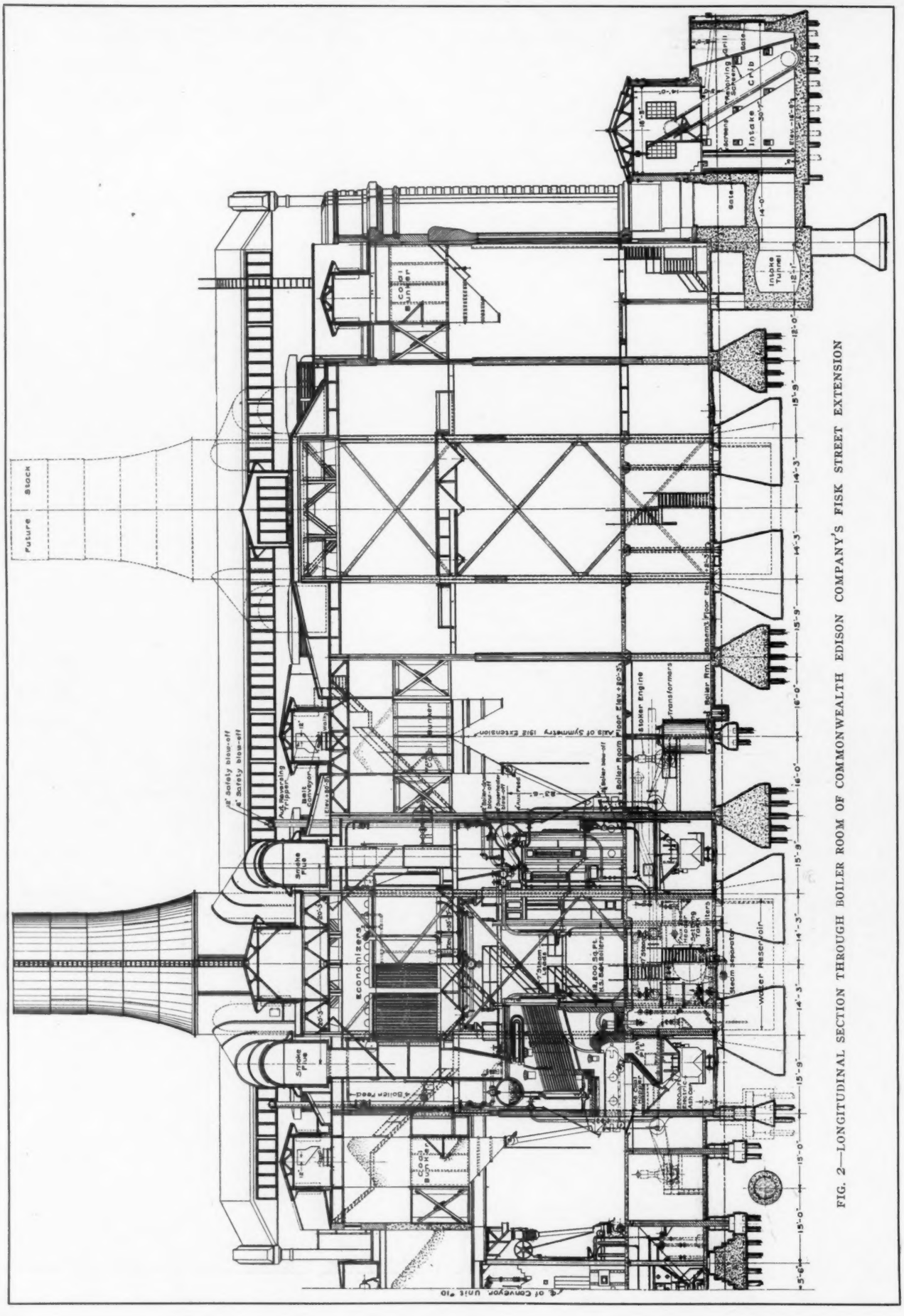


FIG. 2—LONGITUDINAL SECTION THROUGH BOILER ROOM OF COMMONWEALTH EDISON COMPANY'S FISK STREET EXTENSION

The equipment now in service at the Fisk Street station consists of ten vertical Curtis steam turbines and General Electric alternators rated at 12,000 kw each. The new turbo-alternators are of the horizontal type and space is left for two other horizontal units between the turbo-generators now going in and the west wall of the station. A row of boilers extending east and west provides steam for each of the new units. Two of these groups of boilers are now about to be installed, space being left for two others. One smokestack, 250 ft. high above the boiler-room floor and 19 ft. in inside diameter, will serve the boiler equipment for two units.

COAL AND ASH-HANDLING EQUIPMENT

Cars loaded with coal are brought into the train shed on the east side of the station. Two railroad tracks are provided and coal may be dumped directly from the cars into the receiving hoppers above the primary coal crusher. If gondola cars are used, the fuel may be unloaded by grab-bucket cranes and dropped from the side into the crusher hopper. The general arrangement is shown clearly in the general cross-section drawing. The primary crusher is intended to reduce all lumps of coal to about 3-in. or 4-in. pieces. By a system of bucket conveyors the coal is elevated to a point above the boiler-room coal bunkers and delivered to secondary crushers. After being reduced to 0.75 in. size the coal is taken by a belt conveyor connecting at right angles to the bucket conveyors and delivered to the bunkers over the boilers. The bucket conveyors have a rating of 175 tons of coal per hour each at a speed of 45 ft. per minute. The belt conveyor will have a similar rating at a speed of 250 ft. per minute. The bucket conveyors are furnished by the Mead-Morrison Company, the belt conveyor by the Robins Conveying Belt Company, and the crushers by Messrs. Orton & Steinbrenner.

Removal of ashes will be accomplished by means of small electrically driven ash cars operating in the boiler-room basement. These cars discharge into a receiving hopper which delivers the ashes to the bucket conveyors, by which they are elevated to a storage bunker above the tracks in the train shed. From this point the ashes are discharged into cars for removal.

The rating of the coal bunkers for the Parsons 25,000-kw unit is 225 tons per boiler. In addition there are four storage bunkers placed overhead in the train shed, with an aggregate rating of 3360 tons and receiving hoppers having a rating of 1320 tons. The ash storage in the train shed amounts to 1180 tons.

BOILERS AND ECONOMIZERS

For each of the new generating units the boiler equipment will consist of four marine-type Babcock & Wilcox water-tube boilers. These boilers are to be equipped with chain-grate stokers, superheaters and steel-incased settings. The arrangement of the boilers is shown in the drawing giving the general cross-section and longitudinal section of the new portion of the generating station. The boilers are unusually wide, and each one contains 12,200 sq. ft. of heating surface with about 20 per cent of superheating surface. Each boiler is provided with two chain-grate stokers separated by a wall of fire brick, which comes slightly above the surface of the grates. These stokers are each 10 ft. 6 in. wide and 13 ft. long, and are designed to burn a maximum of 45 lb. of coal per square foot of grate surface. Each boiler is designed to evaporate 80,000 lb. of water per hour under maximum working conditions. The maximum working pressure is 225 lb. per square inch, and the normal pressure 210 lb. (gauge). The superheaters are designed to give about 225 deg. Fahr. superheat when operating at or near the maximum capacity.

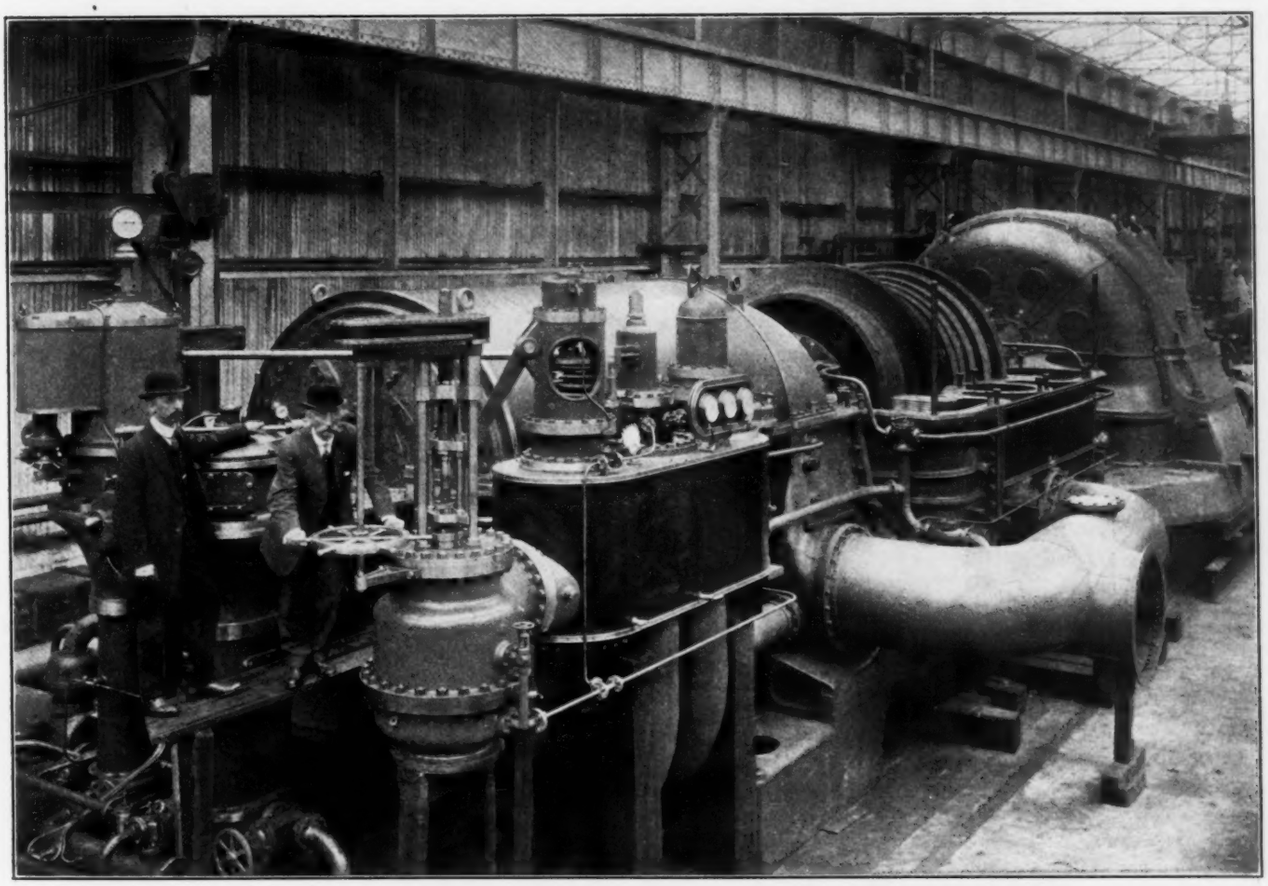


FIG. 4—STEAM END OF 25,000-KW ENGLISH UNIT FOR COMMONWEALTH EDISON COMPANY OF CHICAGO

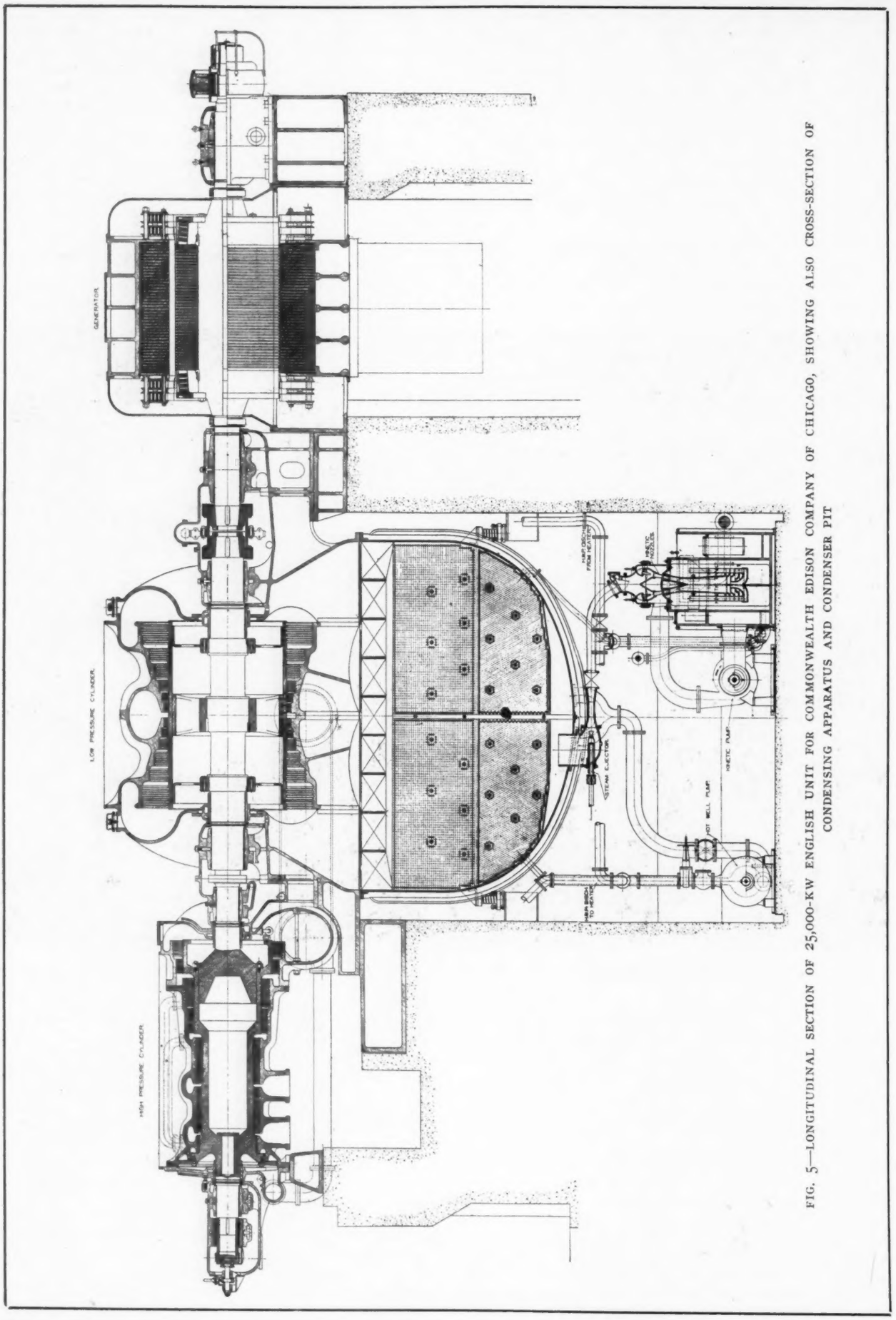


FIG. 5—LONGITUDINAL SECTION OF 25,000-KW ENGLISH UNIT FOR COMMONWEALTH EDISON COMPANY OF CHICAGO, SHOWING ALSO CROSS-SECTION OF CONDENSING APPARATUS AND CONDENSER PIT

As shown in the sectional drawings, the economizers are placed above the boilers. There is one economizer for each boiler. Each economizer contains 8500 sq. ft. of heating surface, provided by 528 12-ft. tubes arranged in three groups and in staggered rows. The three groups are connected in series as regards water circulation. There are sixteen sections of tubes in each group. The circulation in each group is up the first eight sections, down the next four and up the last four. Each economizer is equipped with an induced-draft fan having a rating of 80,000 cu. ft. per minute and designed to maintain 1.5 in. draft in the uptake of the boiler. The economizers are designed to raise the temperature of the feed watr about 150 deg. under ordinary operating conditions. The equipment is furnished by the B. F. Sturtevant Company.

PARSONS 25,000-KW 25-CYCLE UNIT

Imported generating units are rare in electric-service stations in the United States. Much interest is taken, therefore, in Unit No. 11 of the Fisk Street addition, which is the one which has come from England. The machine has a maximum continuous rating of 25,000 kw. The steam turbine is a Parsons machine and is designed with separate high-pressure and low-pressure cylinders. The low-pressure cylinder is arranged on the double-flow principle, as is customary in units of this large size. Accompanying this article are two photographs of the completed unit set up in the Heaton works of the manufacturer in Newcastle. One picture shows the steam end of the great machine and the other the electrical end. The exciter, mounted at the end of the shaft, is shown in the latter picture. In each picture the top half of the low-pressure cylinder casing has been removed for purposes of inspection. A drawing is also given showing a longitudinal section of the new Parsons unit and a cross-section of the condensing apparatus and condenser pit. The arrangement of the condenser is entirely new in this country. The whole unit is about 75 ft. long and 18 ft. wide. The speed of operation is 750 r.p.m.

The generator will produce three-phase 25-cycle current at 4500 volts. It is not designed to be self-ventilating, and no vanes are provided on the rotating field. A separate motor-driven fan is to be installed for ventilating the generator.

Normal conditions of operation for the Parsons turbine contemplate steam pressure of 200 lb., superheat at 200 deg. Fahr. and a vacuum of 29 in. The turbine is designed to develop its best economy when the generator is delivering an output of 20,000 kw, but the unit is capable of delivering continuously a maximum output of 25,000 kw. Further, the machine is capable of caring for an excess demand of about 10 per cent in case of short fluctuations in the load.

The governing mechanism operates on the pulsating principle, giving 320 admissions of steam per minute. When the output is increased above 20,000 kw, a secondary governor valve comes into action, admitting high-pressure steam into the second stage. The atmospheric-relief connection is taken off from the pipe connecting the high-pressure and low-pressure cylinders of the turbine, but two safety valves are provided on the low-pressure casing.

Excitation is provided at a maximum potential of 250 volts. The potential of the station alternating-current busbars is 9000 volts, and therefore compensating transformers wound for 4500/9000 volts are to be placed between the generator terminals and the busbars. These compensators will have an effective reactance of 4 per cent.

CONDENSING EQUIPMENT

As shown by the sectional drawing of the Parsons unit, the condenser shell is virtually suspended beneath the casing of the low-pressure turbine cylinder. Part of the weight of the condenser will be supported, however, upon spring bearings carried on beams set into the concrete foundations. The condenser is designed for a normal rating of 230,000 lb. of steam per hour, a maximum rating of 300,000 lb. and an ultimate maximum for abnormal conditions of 350,000 lb. per hour. It will contain 39,278 sq. ft. of tube surface, composed of brass tubes 15 ft. long and 1 in. in outside diameter. In addition to this main condenser a feed-water heater section is to be built in the steam entrance to the condenser and is to contain 470 sq. ft. of surface. The main condenser will be arranged for two passes of the circulating water.

KINETIC EJECTOR

In addition to the motor-driven circulating and hot-well pumps the condenser will be equipped with a kinetic ejector for the removal of the air and non-condensable vapors. This piece of apparatus, which is not common in this country, takes the place of the so-called "dry vacuum" pump, which is used in the greater part of the large-condenser installations in the United States. It is furnished by Messrs. Richardson, Westgarth & Company, Ltd., of West Hartlepool, England. It comprises a set of water jets, annularly arranged, which entrain the water and non-condensable vapors, removing them from the lower part of the steam space of the condenser. Water is pumped through these jets under a pressure of about 40 lb. per sq. in. by a kinetic pump. It discharges through the nozzles into the kinetic tank just below them, carrying the air with it. The air bubbles up through the water in the tank and escapes through a vent. The kinetic pump has a capacity of 4000 gal. per minute, taking its suction from the kinetic tank. The hot-well pump takes the water of condensation from the bottom of the condenser and discharges it into the kinetic tank. In connection with the kinetic ejector there is a steam ejector between the condenser and the kinetic nozzles, which is used to augment the vacuum. Two sections in the kinetic tank serve the purposes of feed-water heater and hot-well tank. Arrangements are made to save the pure water of condensation in a reservoir, should the supply of water in the hot-well tank be greater momentarily than needed by the boiler-feed pumps.

PUMPING EQUIPMENT

Pumps to be used for condenser auxiliaries and for other purposes in connection with the Parsons unit are furnished by the firm of Henry R. Worthington. Nearly all of them are driven by squirrel-cage induction motors. These motors, together with other motors for driving the coal conveyors, coal crushers, etc., are supplied with three-phase current at 220 volts and 25 cycles from a bank of transformers connected to the main generator terminals. The transformer equipment is duplicated by transformers connected to the main station busbars to be used in starting up or for emergency service. The pumping equipment includes the following machinery: One horizontal tri-rotor volute motor-driven centrifugal pump for circulating water to condenser, rated at 42,000 gal. per minute; one horizontal two-stage motor-driven centrifugal hot-well pump, rated at 750 gal. per minute; one horizontal centrifugal motor-driven pump for use with kinetic ejector, rated at 4000 gal. per minute; two horizontal centrifugal motor-driven service pumps, each rated at 300 gal. per minute; one turbine-driven centrifugal boiler-feed pump and one motor-driven turbine-type centrifugal boiler-feed pump, each rated at 750 gal. per minute.

GUARANTEES OF STEAM PERFORMANCE

When operating at 200 lb. steam pressure at the throttle and with steam superheated 200 deg. Fahr. and exhausting against 1 in. of absolute pressure, Messrs. C. A. Parsons & Company give the following guarantees of steam consumption for the English-made unit:

At 10,000 kw.	12.50 lb. per kw-hour
At 15,000 kw.	11.65 lb. per kw-hour
At 20,000 kw.	11.25 lb. per kw-hour
At 25,000 kw.	11.65 lb. per kw-hour

These figures include the energy necessary for excitation purposes, but do not include the energy needed for the ventilation of the generator. The fan for ventilating purposes will be installed in the space under the generator foundation. It will deliver 80,000 cu. ft. of air per minute and will be driven by a 150-hp induction motor. An air-washing equipment will be installed for cleaning and cooling the air delivered for the ventilation of the generator.

General Electric 20,000-kw, 60-Cycle Unit

Unit No. 14 in the Fisk Street extension will consist of a General Electric horizontal turbo-generator rated at 20,000 kw and having a surface condensing equipment including a condenser with 35,000 sq. ft. of cooling surface. This unit is really the twelfth in order of installation in the station, but its position is such that it is numbered 14. The steam turbine is of the Curtis single-flow type, the first wheel having two rows of buckets and the other single rows of buckets. The shaft bearings are provided with forced lubrication from an oil pump geared to the main shaft. Governing is accomplished by means of the hydraulic system heretofore used on Curtis turbines. The unit will operate at a speed of 1200 r.p.m.

The generator has a continuous full-load rating of 20,000 kw at 80 per cent power-factor, or 25,000 kva. Current is generated at 12,000 volts and 60 cycles. The generator is arranged for self-ventilation by means of vanes on the rotating field. Excitation is provided by means of a 250-volt direct-connected exciter.

Normal conditions of operation for this turbine provide for 200-lb. steam pressure, 200 deg. of superheat and a vacuum of 29 in. The turbine is designed to give its best economy at an output from the generator of about 15,000 kw.

Auxiliaries to American-Made Unit

The entire condenser installation for this unit is furnished by the firm of Henry R. Worthington. The condenser is placed directly beneath the turbine-exhaust outlet. It contains, as previously stated, 35,000 sq. ft. of cooling surface in tubes.

Two circulating pumps are driven from one motor mounted between them on a common baseplate. The combined rating of these pumps is placed at 36,000 gal. per minute at 375 r.p.m. against a total dynamic pressure of 15 ft. The arrangement is that both pumps will ordinarily be used during the warmer months, while in winter one pump will be sufficient. A similar arrangement of two centrifugal pumps and a motor is used in the case of the hot-well pumps. Each hot-well pump will have a rating of 750 gal. per minute and will be ample for the whole load, the second pump in this case being considered as reserve. The dry-vacuum pump is of the reciprocating angle type, as manufactured by the Laidlaw-Dunn-Gordon Company. At a maximum speed of 100 r.p.m. the pump will displace 3340 cu. ft. per minute. Two independent boiler-feed pumps are provided. These are of the horizontal turbine-driven type, each having a rating of 375 gal. per minute. The exhaust from steam-driven auxiliaries is carried to a feed-water heater rated at 300,000 lb. of water per hour, guaranteed to heat the water from 65 deg. Fahr. to 130 deg. Fahr.

A 30,000-kw Unit on Order for Northwest Station

It may be of interest to add that the new unit ordered from the General Electric Company for the Northwest station of the Commonwealth Edison Company, which is several miles from the Fisk Street station, will consist of a horizontal turbo-alternator rated at 30,000 kw, with a surface condenser having 50,000 sq. ft. of cooling surface, and the necessary auxiliaries. This turbine is designed with separate high-pressure and low-pressure cylinders, the latter being arranged on the double-flow principle. In other respects the construction of this turbine will be similar to that of unit No. 14 at Fisk Street, although a somewhat more economical steam consumption is expected. The speed of operation will be 1500 r.p.m. The generator will have a continuous full-load rating of 30,000 kw at unity power factor. Electricity will be generated at 9000 volts and 25 cycles.

The foregoing is a brief outline description of the very large generating units now in course of erection or on order for the Chicago generating stations. These large machines are selected not only on account of their steam economy, but because they are needed owing to the remarkable expansion of the business of the electric-service company of that city. A comparison may illustrate the latter fact. One of the English electrical journals, referring to a tabulation of its own, supposed to be complete, made the statement recently that the output of all the 303 electric-service undertakings in Great Britain and Ireland, both privately owned and municipal, was 1,127,499,742 kw-hr. for the year 1912, or 1911-12. The output of the Commonwealth Edison Company alone in 1912 was, in round numbers, 799,000,000 kw-hr., or two-thirds of that of the entire United Kingdom.

Electrically Operated Machinery in Office-Building Construction

Various hoisting and construction operations about office buildings in process of erection which were formerly performed by steam-driven or gasoline-engine-driven machinery are now being carried on with greater convenience and economy by electric-motor drive. An example of such modern building methods is seen in the First National Bank building in Milwaukee, now in course of construction. The structure is fifteen stories in height and is built of brick and terra cotta.

Located as it is close to the river, a large portion of the water used in the building for flushing temporary sewers and for mixing concrete is being pumped by electricity. For these purposes two electrically driven pumps are installed. One is a reciprocating pump belt-connected to a 1-hp Roth 220-volt motor running at 1800 r.p.m., and the other is a centrifugal pump which is belted to a 2-hp, 220-volt Western Electric motor operating at 1200 r.p.m.

All of the cement used in mixing concrete is delivered at the street level and is wheeled into the main floor of the building, where with the proper proportions of sand and gravel it is dumped into an electrically driven concrete mixer, whose hopper is just below the floor level. After the concrete has been mixed it is delivered directly from the machine to a bucket elevator which conveys it up to the main floor again. From that place wheelbarrows are loaded and placed on an electrically driven elevator which carries them to the floor on which concrete is being poured.

The concrete mixer is connected by chains and sprockets to the bucket elevator and to the Fort Wayne motor which drives it. The latter is of the 50-hp, 220-volt direct-current crane type and operates at 600 r.p.m. Energy is supplied through waterproof cables temporarily suspended from the basement ceiling. The concrete mixer and the motor operating it are both located in the basement of the building.

Three electrically operated elevators are installed at present, and it is expected that another will be added shortly. All of the motors are Fort Wayne equipment—a 20-hp motor operating the material hoist, a 35-hp machine driving a brick and terra-cotta hoist, and a 20-hp motor operating the concrete elevator previously mentioned. In addition to this equipment a Crocker-Wheeler motor is installed on the mezzanine floor and drives a hoisting drum through a worm gear. The latter hoist is employed to raise elevator motors for the building up to the penthouse and for other work which may require heavy slow-speed hoisting.

Carbon and Impregnated Electrodes for Arc Lamps

Composition, methods of manufacture, physical nature, operating characteristics, life and light of electrodes designed for modern street lighting. By A. T. Baldwin

CARBON electrodes for arc lamps fall into two main classes, depending upon the way in which they produce light. The first class, the pure carbon electrodes, depend upon the incandescence of a crater to produce light; the second class, the flaming-arc electrodes, yield light from a luminescent arc stream supplied by the electrodes. The present purpose is to treat briefly of the characteristics of these two classes of electrodes, devoting greater attention to the modern flaming-arc type. Attention will be confined mostly to those electrodes that are used in familiar types of arc lamps seen in street and large area lighting service. The characteristics of these various electrodes may be established by a consideration of their composition, method of manufacture, physical nature and operating behavior. These points will be considered in the order given.

Composition

Pure Carbon Electrodes.—Since electrodes of this class depend upon an incandescent area of carbon for light, foreign substances of lower boiling point than carbon may be considered impurities since they would reduce the crater temperature, so that every effort is made to keep the electrodes free from materials other than carbon. The open arc electrodes are made of coke and a binder. The small amount of foreign substance in this coke makes it unsuitable for inclosed-arc electrodes because a heavy, light-absorbing globe deposit is obtained. As a result electrodes prepared from purer grades of carbon were developed for this service. Their ash content is about 0.10 per cent, which gives a very light globe deposit. Cored inclosed-arc electrodes contain a little more ash due to the salts added to aid in steadying the arc. It may be said here that these cores consist of fine carbon and the salts just referred to, the object being to secure an arc stream of lower resistance for alternating-current lamps and for intensified types of direct-current lamps. The binders used in making these electrodes are tars and pitches derived from coal or petroleum.

Flaming-Arc Electrodes.—In electrodes of this class use is made of any of the many modifications of carbon as a means of presenting at the arc the chemical compounds the luminescence of which in the arc stream yields the light. The cored type of electrodes consists of a shell and a core composed of a mixture of finely divided carbon and the chemical compounds referred to above. These chemical compounds may also be incorporated within the carbon body to make the solid impregnated electrodes now being used in long-burning inclosed-arc lamps. The light and color-giving materials used are essentially the same in either case, although the service demands that they be used in different amounts and relations to each other. The most commonly employed compounds are the fluorides of calcium, strontium and cerium giving yellow, red and white light respectively. Yellow and white flame electrodes are the most practical and the most highly developed, the red being nothing more than an advertising novelty. There are many kinds of "white" flame electrodes, varying in color from a light yellow to a blue white, made in attempts to secure pleasing white light without sacrificing the high efficiency of the yellow flame electrodes.

Methods of Manufacture

The operations involved in making illuminating carbon electrodes fall under the following heads: Reducing all carbon or other solid materials to the desired fineness; mixing the solid ingredients with the binders; forcing the electrodes; baking the electrodes, and various finishing operations, including control testing.

The solid materials are reduced to the desired fineness by means of burr mills and bolting machines. The machines used for mixing the flour and the binders are designed so that the flour is completely covered and permeated by the binder and gives a plastic mass that may be forced into any desired shape by hydraulic presses. The mix is maintained in a plastic state, by keeping it hot, until it is forced through the die by a hydraulic press. As the forced electrodes cool they become rigid and may be handled with

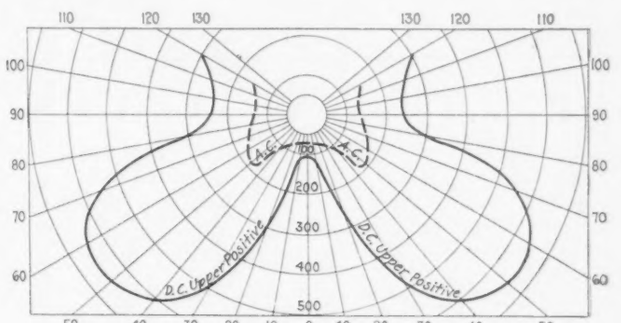


FIG. 1—CURVES OF INCLOSED ARC WITH PURE CARBON ELECTRODES

little fear of destroying their shape. In this condition they pass on to the furnaces to be baked; that is, to have the binder carbonized. Extraordinary care must be exercised in packing the electrodes in the furnaces so that no distortion of the pieces may occur, because they pass through a plastic stage during the bake. After baking, the solid electrodes of all sorts are inspected to eliminate all crooked or otherwise distorted pieces, are gaged to meet size requirements, and are then ready for shipment. Cored electrodes pass through the above steps, and then cores are squirted into the shells after baking. The coring is accomplished by forcing a very plastic mixture into the shell by pressure. After the material has become dry and hard the electrodes are ready for shipment.

Physical Nature

Arc lamp electrodes must be straight, of uniform diameter and have a surface free from irregularities. Their hardness, density and specific resistance are more or less interrelated and are dictated by the service for which the electrodes are designed. Pure carbon electrodes having a low apparent density and a high specific resistance will give the most light since the heat will be conducted away from the crater along the electrode comparatively slowly. This type of electrode naturally will be consumed rapidly. The demands of the American consumer for long trim life require harder electrodes of higher apparent density and lower

specific resistance. This entails some sacrifice in candle-power, which, however, is more than compensated for by the life obtained.

The temperature at the arc ends of flaming electrodes must be kept as constant as possible because this is one of the conditions necessary to provide a uniform supply of vapor to the arc. If the apparent density is not uniform throughout the solid flaming electrodes the heat conduction from the crater end will not be uniform throughout the trim life. If the specific resistance is not uniform throughout the solid flaming electrodes, the heat developed at the crater ends will not be constant. The specific resistance should be low so that there will not be any appreciable change in voltage drop as the electrodes are consumed. Solid flaming electrodes have a somewhat higher specific resistance and real density than pure carbon electrodes owing to the flaming materials used. It is quite important to have the surface of these electrodes smooth and free from any irregularities that might increase the contact resistance at the holders since any unusual state that will vary the standard conditions at the arc will result in serious interference with the proper operation of the arc itself.

The poorly conducting soft core and small cross-sectional area of the long inclined trim type of cored flaming electrodes make their resistance high. Zinc or brass wires are run the length of the electrodes to offset this condition. Furthermore, the contact resistance of these carbons is kept as low as possible by having a metal contact between the electrode and the holder. Many manufacturers accomplish

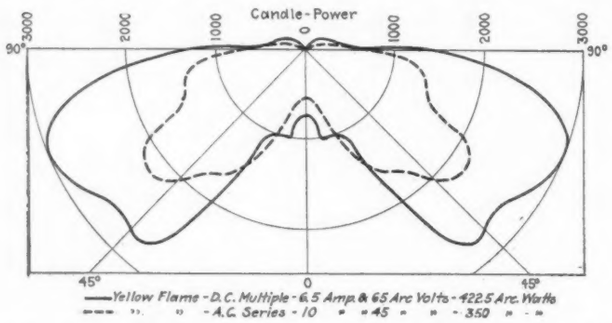


FIG. 2—DIRECT-CURRENT AND ALTERNATING-CURRENT ARCS WITH IMPREGNATED ELECTRODES

this by bending a flattened end of the core wire over the holder end of the electrode. This scheme is not successful since these flattened wires are easily broken and lost from the electrode so that good contact cannot be obtained. The disadvantages of the bent-over wire contact have been overcome by covering the entire holder end of the electrode with a metal tip in such a way as to provide good contact between the core wire and the metal tip. This scheme provides good contact between the holder and all parts of the holder end of the electrode itself instead of just along the narrow ribbon of flattened wire.

Operating Characteristics

Having established the fact that an electrode is reliable and that it will burn satisfactorily under the conditions for which it was built, it is desirable to ascertain how long it will burn, what color light it will give and what candle-power will be obtained from it. In general, knowledge on all these points is necessary before one can determine the practical value of any electrode. The relative importance of these points remains very much as just given except that some commercial conditions may place more importance upon color and candle-power than upon life. In any case the reliability of the electrodes is of primary importance.

Reliability in Operation

Pure Carbon Electrodes.—Electrodes give reliable operation when the arc may be started, stopped and re-started as desired, and burn normally without any interference arising from causes lying within the electrodes themselves. Pure carbon electrodes meet these demands when they are straight, of proper length and diameter for the lamp, and have uniform resistance values for any diameter and class, as is true of coke or lamp-black electrodes. There is very little chance of properly selected pure carbon electrodes not operating reliably, as is indicated by the discussion of these electrodes under previous headings. Most of the troubles encountered result from the use of electrodes of incorrect dimensions or from attempts to operate the lamps under conditions for which the electrodes were not designed. Graphitization of the points of pure carbon electrodes is one of the most common causes of irregular operation. A layer of graphitic carbon is deposited upon the points of one or both electrodes when the arc voltage drops to a certain value. With open-arc lamps this value is about 40 volts and with inclosed-arc lamps it is about 65 volts. After arcs have been operating at these low voltages and consequently with short arc lengths for some time, the graphitic coating appears and causes the arc to break frequently, the light becomes dim and blue, carbon particles are thrown off which blacken the globe and the electrodes spindle away in back of the graphitic layer. If the arc voltage and length become normal again the graphitic coating will gradually disappear. Any condition that will cause the arc voltage to be low or the arc length short, will produce graphitization.

Flaming-Arc Electrodes of the Cored Type.—Electrodes of this type depend upon a soft core to supply the flaming (light-giving and color-giving) materials to the arc. The cores must contain the essential materials in their proper proportion and must be securely held in place. The non-conducting slags such as are encountered with solid flaming electrodes do not appear if the lamps are operated properly. These electrodes are burned in an inclined position and at an angle of about 22 deg. to each other. The best operation is obtained when they are trimmed so that the arc is struck and maintained at certain arbitrarily chosen positions in the "economizer," a cup-shaped chamber placed above the arc to protect it from drafts and to prevent a too rapid dissipation of the heat. The electrodes as used in pairs must be of exactly equal lengths and of the proper diameter for the lamp in order to meet the conditions just given. The importance of the core wire and of good contact at the holders upon the lamp regulation has already been touched upon. Poor regulation of the lamps using cored-type flaming electrodes, whether brought about by any of the conditions just mentioned or by wrong adjustment of the lamp mechanism, will result in the arc and the light being unsteady and in shortened life.

Flaming-Arc Electrodes of the Solid Type.—These electrodes, being much shorter and thicker than the cored type, are not very liable to cause irregular operation from such conditions as occur with the cored electrodes. Solid flaming electrodes are burned in a vertical position, one electrode being directly superposed over the other so that any diameter or length may be chosen for each electrode, thereby giving greater flexibility to the design of the lamps. This method of burning the electrodes provides opportunities for the formation of non-conducting slags in positions where they can insulate the electrodes from each other. A slag is composed of flame materials which collect in a fused state in any position about the electrode points. It assumes well-defined forms which are due mainly to the nature of the materials used and to the conditions under which the electrodes are burned and are generally called "beads," "trees" or "rims," depending on their shape and position. It is possible for any one or more forms of slag to occur with the same trim of electrodes.

Slags may form either from the presence of excessive amounts of flaming materials at the points of the electrodes or from the condensation of the vapors of the arc stream.

Any condition that will tend to lower the temperature of the arc will tend to form slag. Low current tends to form slag since there is not sufficient energy present at the arc to volatilize all the flame material. At present solid flaming electrodes are made for consumption in inclosed-arc lamps of a new type. Poor inclosure of the arc in these lamps due to any cause will increase the rate of carbon consumption, leaving an excess of flame material in a position to form a slag. An economizer is used in many makes of enclosed flaming arc lamps to decrease the burning rate of the upper carbon. Situated just above the arc it receives considerable deposit from the dust-laden gases which, when fused, may prevent the free movement of the electrodes. The arc must be situated in a neutral or symmetrical magnetic field to prevent it from being blown to some definite position where it might produce side-burned electrodes and slag.

LIFE

Pure Carbon Electrodes.—The time taken to consume pure carbon electrodes is determined by the current density at the electrode ends and by the ease with which the supply of oxygen at the arc is replenished. The long life obtained from inclosed-arc lamps depends mostly on the second factor, since these lamps are built to supply as little fresh air (oxygen) to the arc as steady operation will permit. Increased current density increases the rate of consumption.

Many diameters and shapes of electrodes were made for open-arc lamps giving trim life values between six hours and twenty hours, depending upon the diameter and number of inches of the electrodes available for consumption. Ordinary electrodes had diameters from 7/16 in. up to ¾ in. and in most cases were round, although many elliptical, partly rounded, flat or plate electrodes were used. The standard length for the electrodes was 12 in. Copper and other metal coats were plated on the electrodes to decrease the rate of oxidization and thereby increase the life. With the smallest electrodes this scheme would add about one hour, or 15 per cent, to the trim life, and with the larger electrodes the life would be prolonged in approximately the same proportion. These metallic coats were more valuable, probably, in affording good holder contact and in reducing the voltage drop along the electrodes. As experience was obtained the importance of protecting these arcs from drafts of air which greatly shortened the life became apparent. It became obvious that a uniform trim life depended very largely on having the electrodes washed by only such drafts as would be created by the ascent of the hot gases from the arc.

The discussion covering open-arc electrodes has been written in the past tense as if such electrodes were no longer used. Such an impression would be incorrect, because many hundreds of thousands of these electrodes are consumed annually. In one of the best lighted cities in the United States use is made of a special plate type almost exclusively with quite satisfactory results. These electrodes are utilized in a specially constructed lamp, and a life of from twenty-five hours to seventy-five hours is obtained, depending upon the condition of operation and the size of the electrodes.

The inclosed-arc lamp, operating at lower currents and higher arc voltages than the open type, depends almost entirely upon the uniformity of its inclosure for uniformly high trim life values. While the current density of the electrodes does influence the life, its effect is secondary to that of the inclosure. As an illustration consider similarly made direct-current lamps operating at 5 amp and at 6.6 amp, with ½-in. by 12-in. solid pure carbon electrodes. The increase of 1.6 amp will decrease the trim life by about 10 per cent, while an almost imperceptible crack in the globe or chip along the gas cap surface will reduce the trim life by from 20 to 30 per cent. If fresh air enters at the bottom of the globe, this effect is most exaggerated. Again, there are great differences between the trim life values obtained from the same lamp and similar electrodes when operated in-doors and out-doors. The effect of varying the inclosure upon the life may be shown to some extent by noting the effect of the weight of the gas cap in a lamp having a removable gas cap when other conditions are held constant. The tests recorded below were made in a 5-amp direct-current multiple lamp:

TABLE I—ELECTRODE LIFE

Weight of Gas Cap, in Grams	Hours Burned	Hours per Inch
260 to 275	222.5	26.3
170 to 180	162.9	19.4
45	147.25	17.3

It has already been pointed out that softer electrodes are consumed more rapidly. In so far as the electrodes are concerned, it is necessary that their diameter be uniform and of the exact size for the lamp in question, otherwise the air admitted to the globe around the electrodes may affect the life. An illustration of this will be given later.

FLAMING-ARC ELECTRODES

Cored Type.—The lamps burning cored flaming electrodes are of the open-arc type, showing many improvements over open-arc lamps burning pure carbon electrodes. The introduction of deep protecting economizers and the use of globes admitting most of the fresh air around their top have been conducive to longer life and greater arc steadiness. Lamps are rated to burn from ten to thirty hours, the life being determined almost entirely by the length of the electrodes, although in some cases a partial inclosure of the arc is attempted in order to decrease the burning rate. The life may be prolonged somewhat by raising the arc in the economizer, while any lowering of the arc below its normal position will reduce the life materially. Electrodes short in length or small in diameter will not give the rated trim life. Any condition that will cause the arc to break frequently will tend to reduce the life because material will be pounded off the electrodes and unnatural drafts will be produced in the economizer.

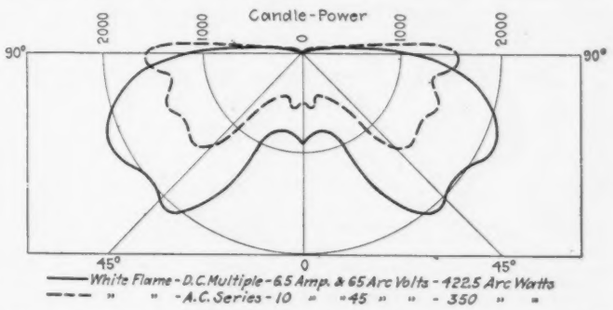


FIG. 3—DIRECT-CURRENT AND ALTERNATING-CURRENT ARCS WITH IMPREGNATED ELECTRODES

Solid Type.—These electrodes are designed for service in inclosed-arc lamps built to burn from 70 to 125 hours, so that all that has already been said concerning the influence of inclosure upon the trim life of pure carbon electrodes applies here. The life is determined to some extent by the volt-amperes at the arc, higher wattage tending to give shorter life. Spindling of the carbons produced by high current, irregularly shaped points and the change of atmosphere accompanying arc rupturing all tend to shorten the life.

Table II illustrates the influence of inclosure on trim life, the variations in inclosure being made by varying the size of the gas-cap opening. Similar results will be obtained in

lamps using electrodes of diameters other than those used in this test, although the effect as expressed in percentage will not be the same. This experiment was performed in an inclosed flaming-arc lamp where it was possible to vary the size of the upper carbon passage (gas-cap opening) and in that way vary the inclosure.

The burning ratio between the two electrodes in focusing type lamps must be retained as designed by the lamp maker to secure the most advantageous use of the electrodes. Any change in the regularity of the electrode consumption that will alter this ratio will change the light steadiness and distribution, vary the globe deposit, and may result in the destruction of lamp parts from the heat of the arc. Globes that leak, and, in direct-current lamps, reversed polarity, are the most common causes of change of burning ratio.

COLOR OF LIGHT

Pure Carbon Electrodes.—The light given by pure carbon electrodes has long been considered the nearest approach to daylight in color. The open arc was considered to give a nearer approach to daylight than the inclosed arc where the longer arc stream and higher arc voltage resulted in the emission of a greater amount of light at the blue end of the spectrum. Inclosed-arc lamps burning pure carbon electrodes at high current density have been developed which are now considered the nearest approach to average north sky daylight. In these lamps the effect of the blue rays is counterbalanced by those of longer wave-lengths emitted from the enlarged crater resulting from the high current

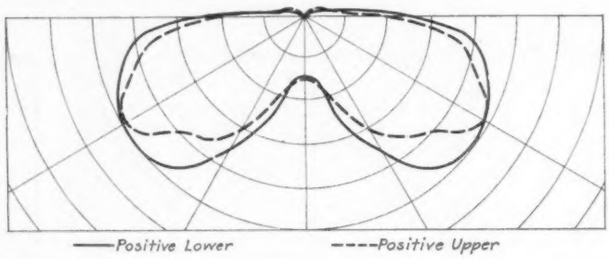


FIG. 4—EFFECT OF POLARITY ON INCLOSED ARC WITH IMPREGNATED ELECTRODES

density used. In general, it may be said that the ways in which the light given out by pure carbon electrodes may be varied are by changing the arc voltage, which increases the tendency to add blue to the light, and by increasing the current density or using very soft electrodes to obtain red and yellow rays from the enlarged craters that are formed.

TABLE II—EFFECT OF INCLOSURE ON LIFE

No.	Electrodes, In.	Diam. of Gas-Cap Opening, In.	Clearance Area in Per Cent of Electrode Area	No. Trims Tested	Average Arc Volts	Average Amperes	Average Hours	Life, Per Cent	Condition of Points†
1	0.874	0.900	6.16	5	63.5	7.7	116.7	100	Good
2	0.874	0.930	13.5	3	62.9	7.4	115.6	99	Good
3	0.874	0.960	21.2	4	61.7	7.4	98.4	84	Fair
4	0.874	1.000	31.6	5	65.7	7.7	92.0	78.8	Poor
5*	0.874	0.900	.....	1	65.0	7.5	41.0	....	Very poor

*An inner globe with a hole 3 in. in diameter was used in this case. No outer globe.
†This refers to the amount of slag on the carbon points at the end of the test; points free from slag are called good.

Flaming-Arc Electrodes.—As previously stated, electrodes of this type depend on certain chemicals incorporated within them for their color and also for their candle-power. Yellow and whites of various sorts are the colors most frequently used, and consequently are the kinds of electrodes most highly developed. Just what constitutes a yellow or a white is largely a matter of the personal opinion of each observer at present.

The yellow color of the cored type of electrodes in inclined open-arc lamps is accepted by many as a standard. If the arc operates normally throughout the burning period the color remains the same. Either inclosing the arc or increasing the current bleaches the color and it seems to fade. Yellow flaming arcs in inclosed lamps show this fading to a marked extent, as the excess air in the globe is consumed when the arc is started. As the current is increased the candle-power increases as does also the intrinsic brilliancy of the source, which may be considered the reason for the color becoming whiter, it being well recognized that the higher the intrinsic brilliancy of the source the whiter the light.

These same facts have been observed in general with white flaming arcs. The field for comparison is made more complex here, however, by the many different so-called whites, the most important of which may be called pearl whites (light yellows) and snow whites (blue whites). As a general observation it is more satisfactory to operate white flame arc lamps at 10 amp rather than at lower currents, the color being steadiest and most pleasing at this current.

In the most recent flaming-arc lamps for direct-current service, those of the inclosed, long-burning type, both electrodes are impregnated so that reversed polarity does not produce color changes and loss in candle-power such as is encountered in lamps using a neutral or very slightly impregnated negative electrode.

CANDLE-POWER

The property of commercial electrodes to yield light is their most important function, and some idea of the great efforts exerted to compare various light sources on a candle-power basis can be gained by even a casual glance through electrical literature. Mean spherical candle-power is the best basis for measuring the actual efficiency of various arc sources themselves, while a candle-power distribution curve of a given electrode in the lamp for which it was designed is the best measure of various arc-lighting units.

The candle-power of pure carbon arcs is determined by the size of the crater (the current density) and to some extent by the arc length. With flaming arcs the candle-power may increase somewhat with increased arc voltage, but this is not nearly so important as the current and the arc length where an increase in either, and especially in the current, is followed by an increase in the candle-power. As previously stated, white flame electrodes operate better at a current of 10 amp than at lower values. In addition to the steadier more pleasing color, the efficiency is greatly improved. Table III illustrates.

The writer has noticed in comments on the inclosed flaming-arc lamps in the recent literature that great concern was felt lest the high efficiency of the open-type flame-arc lamp would be sacrificed by inclosing the lamp, the various writers evidently having in mind the results that followed the inclosing of the pure carbon arcs. That such fears are groundless is shown by Tables IV and V, which compare inclosed pure carbon and flaming arcs with open-type (inclined electrode) flaming arcs, first in alternating-current multiple lamps and then in direct-current multiple lamps. In the case of the open-type lamps, where they were built to operate two in series across 110-volt constant-potential circuits, a resistor was submitted for the second lamp. All mean spherical candle-power readings noted in this paper relate to the arc itself, the proper corrections for glassware absorption having been made. The measurements were made on a standard sphere using the Sharp-Millar photometer box.

In alternating-current lamps it is clearly shown that even the least efficient solid-flaming electrode burning under in-

closed-arc conditions is more efficient than the most efficient cored type electrode, while in direct-current lamps with two of the three colors measured, electrodes of the same color burn more efficiently under inclosed-arc conditions, and with the third color, the pearl-white electrodes, the difference in efficiency may fairly be considered insignificant.

These tables may be misleading, since they are built upon

TABLE III—OUTPUT AND COLOR OF LIGHT

Type of Lamp	Current	Arc Volts	True Arc Watts	Mean Spherical Candle-Power	Mean Spherical Candles per Arc Watt	Color of Light
A. C. multiple, long-burning...	7.9	57	417	985	2.36	Pearl white
A. C. multiple, long-burning...	10.2	47	443	1459	3.29	Pearl white
A. C. multiple, long-burning...	7.7	58	418	1020	2.44	Snow white
A. C. multiple, long-burning...	10.2	49	442	1396	3.16	Snow white
D. C. multiple, long-burning...	6.8	57	387.6	797	2.05	Snow white
D. C. multiple, long-burning...	10.0	48	480.0	1103	2.30	Snow white

a measurement of all the light rather than upon the useful light. For instance, the specific consumption of the inclosed arc would here be considered from three to eight times as high as that of flaming electrodes in alternating-current lamps and from three to five times as high as that in direct-current lamps. The facts under the conditions named are as shown, but do they truly represent the superiority of flaming arcs over inclosed pure carbon arcs? The accompanying distribution curves will give a truer comparison in so far as the interests of the arc lamp user are concerned. The curves of the inclosed arcs (Fig. 1) are quite characteristic, showing clearly the influence of each crater and the arc stream on the distribution of the light. In each case the angle of maximum distribution is about 40 deg. below the horizontal, while with the flame lamps this angle lies between 20 deg. and 30 deg. below the horizontal, conditions recognized as giving a better light distribution. An analysis of the curves (Figs. 2 and 3) shows that the relative efficiency of the various types compared is practically the same in direct-current lamps whether based on the total flux or upon the distribution. In alternating-current lamps, however, it becomes quite apparent that a comparison based upon the total flux of light does not fairly show the superiority of modern alternating-current flaming-arc lamps over the older inclosed pure carbon arcs. In direct-current lamps flaming electrodes are from three to five times as efficient as inclosed-arc electrodes, while in alternating-current lamps the flaming electrodes are from five to fifteen times as efficient based upon their distribution and from three to eight times as efficient based upon their total light flux. These curves are not for lamps of the same current and arc voltage, but are taken as typical of each type of electrode in a lamp adapted for it.

The curves of Fig. 4 for the white flaming electrodes afford a comparison of the effect of the polarity upon the distribution. As is apparent to the eye of an observer, the curves clearly bring out the great increase in candle-power that accompanies the use of the lower carbon as the positive. In the curves shown the light output increases by more than 600 candles along the angle of maximum distribution when the only change is from an upper to a lower positive carbon. A better light distribution is obtained and the arc operates more steadily.

TABLE IV—COMPARATIVE EFFICIENCY IN ALTERNATING-CURRENT LAMPS

Type of Lamp	Electrodes	Color of Light	Amperes	Arc Volts	True Arc Watts	Mean Spherical Candles	Mean Spherical Candles per Watt
Inclosed...	Pure carbon...	Blue white.	16.2	72.6	409	231	0.58
Open.....	Cored flaming..	Snow white..	10.0	46.0	399	752	1.88
Open.....	Cored flaming..	Pearl white..	10.0	45.0	390	1062	2.72
Open.....	Cored flaming..	Yellow.....	10.1	44.0	384	1149	3.00
Inclosed...	Solid flaming..	Snow white..	10.2	49.0	442	1396	3.16
Inclosed...	Solid flaming..	Pearl white .	10.2	47.0	443	1459	3.29
Inclosed...	Solid flaming..	Yellow.....	8.0	56.0	388	1538	3.96

TABLE V—COMPARATIVE EFFICIENCY IN DIRECT-CURRENT LAMPS

Inclosed...	Pure carbon...	Blue white..	5.1	79.0	402.9	272	0.67
Open.....	Cored flaming..	Snow white..	10.0	45.0	450.0	732	1.62
Inclosed...	Solid flaming..	Pearl white..	9.8	49.0	485.2	976	2.03
Open.....	Cored flaming..	Pearl white..	10.0	45.0	450.0	959	2.14
Inclosed...	Solid flaming..	Snow white..	10.0	48.0	480.0	1103	2.30
Open.....	Cored flaming..	Yellow.....	10.0	46.0	460.0	1223	2.69
Inclosed...	Solid flaming..	Yellow.....	7.0	60.0	420.0	1380	3.29

Decreasing the Duration of Service Interruptions at Marion, Ind.

If a service interruption occurs on Sundays, holidays or at other times when most of the operating men and repair crew of a central station are enjoying a few hours' leisure, thirty minutes or more is generally required for getting together a sufficient force to attempt to repair the trouble. After experiencing several such delays in making necessary repairs after thunderstorms and similar occurrences, Mr. S. H. Smith, manager of the Marion Light & Heating Company, of Marion, Ind., evolved a system of organization which in a large measure reduces all such delays to a minimum.

According to the rules of this system, as soon as a storm cloud appears in the sky or the first clap of thunder is heard all of the operating and repair men telephone to the plant, giving their names, telephone numbers, whereabouts and their probable movements for a reasonable period of time as accurately as possible. These facts are recorded at the station by the man at the telephone, who is generally one of the operating force on duty, and if the occasion arises each man who has reported can be reached at the number he has given. The same rule has been adopted for holidays so that at all times it is possible to collect quickly a crew to repair almost any kind of service interruption.

All of the men in the operating and maintenance departments, including the manager, are included in the list of those required to make their whereabouts known. Following a service interruption the list of men calling can be referred to, and in case any man has failed to report it is shown on the record. When this man's attention has been directed to the breach of discipline by the manager and an explanation demanded it is very probable that the forgetful culprit will on the next occasion be the first to call the station and inform the man in charge of his telephone number and his immediate movements.

It is stated that instead of the thirty minutes which were formerly required to start to make repairs the present system usually shows a man close enough to the trouble to be "on the job" in less than one-third of that time.

The Nitrogen-Filled High-Efficiency Tungsten Lamp

Blackening of bulbs and its prevention—Introduction of nitrogen at atmospheric pressure to reduce filament evaporation and localize deposits by convection currents—Lamps of 4000 cp consuming 0.4 to 0.5 watt per candle over lives of 1500 hours

BEFORE the meeting of the American Institute of Electrical Engineers held in New York City, Oct. 10, Dr. Irving Langmuir, Schenectady, N. Y., described the development and present status of the new nitrogen-filled tungsten incandescent lamp, presenting two closely related papers which President C. O. Mailloux in his introduction characterized as marking an epoch in electrical history and electrical progress. The first paper discussed the phenomenon of blackening in tungsten lamps and methods of preventing it. The second, prepared in collaboration with Mr. J. A. Orange, described in detail the high-efficiency tungsten lamps which have been produced by filling the bulbs with nitrogen vapor at about atmospheric pressure.

Causes of Blackening in Tungsten Lamps

The modern tungsten lamp, as pointed out by Dr. Irving Langmuir in the first paper, has an absolute luminous efficiency of but 6 to 10 per cent based on perfect white-light production at 0.10 watt per candlepower, and monochromatic yellow-green production at 0.06 watts per candlepower. Tungsten lamps of to-day fail not by breaking of the filament, but by reduction in light-giving value due to blackening of the inner globe surface. With attempts to increase efficiency of lamp operation, this blackening process has been found to be greatly accelerated, thus heretofore placing a limit on the consumption efficiencies obtainable consistent with reasonable lamp life.

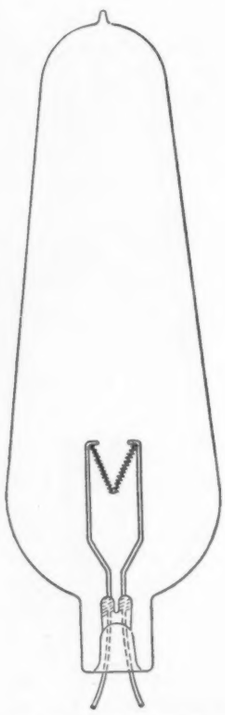


FIG. 1—LOW-VOLTAGE NITROGEN-FILLED LAMP, 0.4 TO 0.5 WATT PER CANDLE

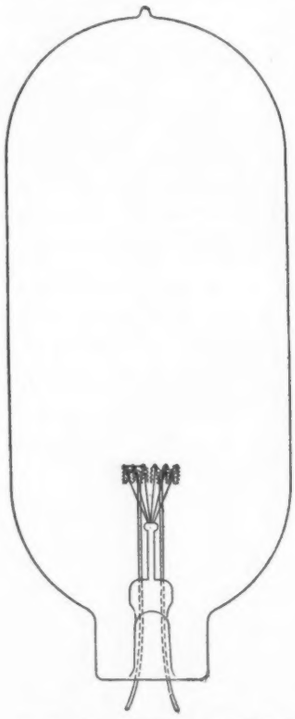


FIG. 2 — NITROGEN-FILLED LAMP FOR 110-VOLT CIRCUIT.

Such blackening has generally been attributed to disintegration of the filament caused by traces of residual gas in the bulb, although in the case of lamps run at overvoltage evaporation of the filament was assigned as the cause. From analysis of possible sources of gas within lamp bulbs, the following gases were found by the investigators: Water vapor, carbon dioxide, carbon monoxide, hydrogen, nitrogen and hydrocarbon vapors. Further tests showed that water vapor is the only gas which produces perceptible blackening. Its part in this cyclic process is that of a carrier, the water oxidizing the tungsten and being itself reduced to atomic hydrogen. The tungsten oxide meanwhile becomes volatilized and deposits on the glass bulb where it is reduced by the atomic hydrogen back to metallic hydrogen with the formation of water vapor again.

But attempts to reduce the quantity of water vapor have resulted in failure, so that the author's conclusion is that while water-vapor reduces the life of poorly exhausted lamps, it can be nothing else than pure evaporation of the filament at high temperature which produces blackening in the case of well-exhausted bulbs. To prevent such blackening, due to evaporation, two methods are available; (1) to reduce the rate of evaporation by introducing into the bulb at atmospheric pressures such gases as nitrogen and mercury vapor, and (2) to change the location of the deposits by means of convection currents in gases inside the bulb, so that the glass opposite the filament will not darken. At atmospheric pressure this localized darkening effect of the convection currents in the gas becomes very striking, the globe on a level with the filament remaining perfectly clear, while a dark deposit gradually forms on the parts directly above the filament. Thus the introduction of an inert gas into the bulb at atmospheric pressure not only decreases the rate of filament evaporation, but by proper design of the lamp parts the presence of this gas may be made to prevent blackening of those glass surfaces through which light is transmitted, the result being to make possible increased lamp life at high efficiencies.

Nitrogen-Filled Tungsten Lamps

In the second paper of the evening, Dr. Langmuir and Mr. J. A. Orange described practical applications of the principles already outlined. By the use of these they have been able to construct large tungsten lamps which, starting with an efficiency of 0.40 watt per candlepower, have run over 2000 hours, with an average efficiency of 0.5 watts per candle over that period.

Experiments with filaments of various sizes early indicated the desirability of using large diameters. The larger filaments gave not only a better efficiency at any definite temperature, but also a much longer life. Thus doubling the diameter decreased the consumption from 0.65 to 0.56 watt per candle, and increased the life from 90 to 300 hours. This improvement in efficiency is attributed to the relatively greater heat loss by convection from small wires. The life of the filament is determined largely by the loss of tungsten from the filament by evaporation, and has been found to be dependent on the relative decrease in diameter thus caused. The evaporation of tungsten in nitrogen is largely a diffusion process, and is nearly independent of the

size of the wire. The rate of evaporation per unit area is thus inversely proportional to the diameter. Relative lives of very small wires in nitrogen as therefore nearly proportional to the squares of their diameters.

But filaments of large diameter require very large currents to maintain them at the operating temperature, 2850 deg.; hence unless very low voltages are used, the power consumed by the larger wires is so large that only lamps of high candlepower could be made. To increase the effective diameter of the filament without decreasing its resistance, a tubular section might be used, but the more practical construction, and the one adopted, takes the form of winding the filament into a tightly coiled helix. Among the advantages incidentally obtained is the automatic correction of local overheating of thin spots in the filament, which would otherwise magnify themselves rapidly. But in the helical filament such an overheated soft spot will be pulled open by the normal tension and sag of the filament, preventing further progress of overheating by providing increased radiation and convection.

In ordinary lamps about 20 per cent of the energy radiated from the filament is intercepted by the glass and causes heating of the bulb. In the nitrogen-filled lamp, beside this radiated heat, there is an additional amount of heat carried to the bulb by convection—an amount varying with the type of lamp and ranging from 6 to 40 per cent. The convection currents carrying this relatively large amount of heat, travel vertically upward within the bulb, and if they strike a small area of glass, tend to overheat it. This overheating may liberate enough water vapor to cause attack on the filament and blackening of the bulb. The filament should therefore be placed in the lower part of the bulb, and sufficient area allowed in the upper glass surface for the deposit of tungsten nitride.

For bulbs of the same volume the nitrogen lamps give roughly from five to ten times the candle-power of evacuated lamps, but the bulbs of such filled lamps naturally run much hotter than those of ordinary lamps. The upper parts of the bulbs are often 100 to 200 deg. Cent. or more, while the lower parts are sometimes much cooler than this, although closer to the filament. Several special varieties of heat-resistant glass have been used for the bulbs, making considerably smaller sizes possible, as well as rendering it easier to get rid of water vapor.

Special lead-in wires have had to be devised to convey the heavy currents (20 to 30 amp) involved in the larger sizes of these new lamps. Platinum has been discarded entirely, even in the smaller lamp sizes, special alloys being substituted which have the same coefficient of expansion as the glass. Bulbs of special glass into which tungsten or molybdenum wire can be sealed directly, have also been tried. Where the leads enter from the top of the bulb, special precautions have to be taken to protect the wires against the high-temperature convection currents.

Types of High-Efficiency Units

For the particular type of nitrogen-filled tungsten lamp at present furthest developed, lives of over 1500 hours at efficiencies better than 0.50 watt per candle have been obtained only in large units taking over 10 amp. Lamps running at 0.6 to 0.7 watt per candle, have been made in units taking at least 5 amp.

No serious difficulty has been met in making high-voltage lamps of this type, for in nitrogen at atmospheric pressure there is no tendency toward arcing, even at 250 volts. Many lamps taking 6 or 7 amp at 110 volts have been made up and run at 0.6 to 0.7 watt per candle, with a life of over 1000 hours.

A number of special types of nitrogen-filled lamps which have been made and tested are the following:

1. Large units of very high efficiency (0.4 to 0.5 watt per candle with a life of 1500 hours or more). These lamps take currents of 20 to 30 amp and (except in units over 4000 cp) are therefore best run from alternating-current circuits by means of small transformers or auto-transformers giving a voltage depending on the size of unit desired. Thus, with 30 volts and 25 amp, the power taken would be 750 watts and this, in a lamp of say 0.45 watt per candle, would give 1670 cp. Higher or lower candlepower may be obtained by using other voltages. A typical lamp of this kind is shown in Fig. 1.

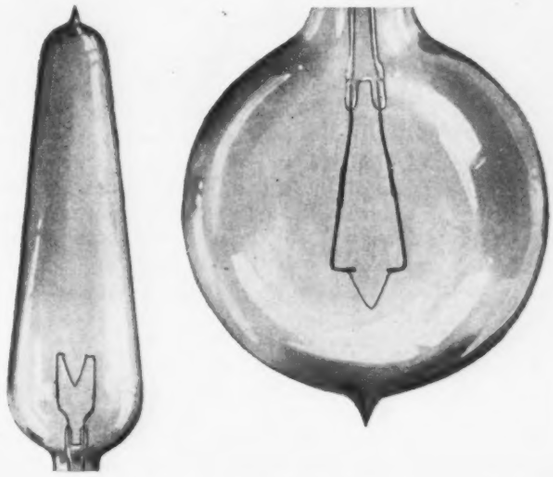
2. Small units of low voltage. These take currents of 10 amp or less and work at pressures as low as 4 or 5 volts. The efficiencies with 1000-hour life range from 0.6 to 1.0, or even 1.25 watts per candle, according to the current used. These lamps are adapted for series street lighting on 6.6-amp circuits (at 0.6 to 0.7 watt per candle), for stereopticon lamps, for automobile headlamps, and for use in general wherever a source of high intrinsic brilliancy, steadiness and white color is needed.

3. Lamps to run on standard lighting circuits (110 volts). Large units of this type (several thousand candle power) have efficiencies of 0.5 watt per candle or better. With smaller units the efficiency is ordinarily not so high. A type of this lamp is illustrated in Fig. 2. The leads may be brought in from the top, in which case they are preferably made very long so that the filament remains in the lower part of the bulb.

Special Advantages of Nitrogen-Filled Lamps

Besides high efficiency, features of the new lamps which may prove of advantage are:

1. Color of the light. The temperature of the filament



FIGS. 3 AND 4—2000-CP AND 1500-CP NITROGEN-FILLED TUNGSTEN LAMPS

being 400 to 600 deg. higher than that of ordinary lamps, causes the light to be of a very much whiter color, so that it comes closer to daylight than any other form of artificial illuminant except the direct-current arc and the special Moore tube containing carbon dioxide. The color is almost exactly like that which can be had for a few minutes by running an ordinary tungsten lamp at double rated voltage.

Work is at present under way to develop special color screens which, when used with this light, will give a true daylight color (corresponding to the radiation from a black body at 5000 deg. Cent.). Such screens will absorb from 65 to 75 per cent of the light, so that the net efficiency will be about 2.0 watts per candle for a pure daylight color. With ordinary tungsten lamps, the absorption screens now used give a net efficiency of hardly 10 and 12 watts per candle.

2. High intrinsic brilliancy of the filament. At the operating temperature of the nitrogen-filled lamps the intrinsic brilliancy of the filament is about 1200 cp per sq. cm. In ordinary tungsten lamps, on the other hand, running at

about 1.25 watts per candle, the filaments have a brilliancy of only about 150 candle power per sq. cm. This feature, combined with the high degree of filament concentration, renders these lamps particularly useful for projection work in head-lamps and stereopticons.

3. Constancy of characteristics during life. It is often possible to design these lamps so that their current, pressure, and candle power characteristics remain practically fixed during the greater part of their lives. In any case, however, since there is no deposit on the bulb to cut off the light, the candle power practically never falls below 75 per cent (this decrease sometimes being due to sagging). The lamp usually fails by the breakage of the filament, with the candlepower well above 80 per cent of its original value.

The spherical candle power of many of these lamps has been measured. The ratio of mean spherical to maximum horizontal (practically mean horizontal also) candle power has been found to average about 84 per cent for the lamps made with single loops of helically wound wire.

As an appendix to their paper, the authors also outlined methods of photometering the new high-efficiency lamps with the aid of blue-glass screens. The constants for these glasses having been once determined, there are available a number of standard temperatures ranging from 2250 to 3600 deg. K. By the use of these screens it is an easy matter to set a lamp up at a voltage such that the filament has a standard temperature, say 2850 deg. To do this it is simply necessary to adjust the voltage so that the color of the light from the lamp is the same as that which comes from the standard lamp when viewed through one of the special blue screens.

Discussion

Those who took part in the discussion of the two papers were Messrs. John B. Taylor, John W. Howell, Farley Osgood, J. E. Randall, William McClellan, John W. Lieb, Jr., H. M. Fales, and M. G. Lloyd.

Mr. Taylor projected on the screen an enlarged image of a nitrogen-filled lamp backed by a reflector, and called attention to the advantages of the new unit for projection-lantern purposes. Compared with the usual arc source, it is much more convenient and uniform in operation, and almost as white in color.

Mr. Howell complimented the researches of Dr. Langmuir, particularly his painstaking experiments giving rigorous proof of what were hitherto only theories. But taking exception to the author's statement that ordinary tungsten lamps fail chiefly by blackening of the bulbs, the speaker pointed out that this observation was intended to apply only to large lamps, and is not true of the small sizes which constitute 75 per cent of the present commercial output. Lamps like the 40-watt units remain useful until the filament breaks or weakens due to evaporation. Their bulb area, being relatively large, greatly reduces visible blackening. Mr. Howell said he had long recognized three kinds of blackening, the chief of these actions being that due to evaporation, which advances uniformly during the life of the lamp. Many lamp authorities have in the past held this theory. Irregular or mottled discolorations, on the other hand, may be traced to the presence of a residual gas. The presence of water vapor affects carbon and tungsten lamps very differently as shown by examples which the speaker exhibited. Water vapor in the carbon lamp renders the filament sooty and black, increasing its radiation and reducing its candlepower by one-half, although the globe remains clear. Later this soot is deposited on the glass, causing blackening.

Mr. Randall submitted a tabulation representing an attempt to evaluate recent progress in lamp development. If 90 per cent of the theoretical candlepower-hours are developed in 1000 hours' burning (candlepower maintenance and mortality being both considered) the advance from the raw carbon lamp, fixed as 100, he estimated as follows:

Raw carbon filament (cellulose)	100
Treated carbon filament	119
Graphitized-carbon filament	149
Tantalum filament	206
Osmium filament	270
Tungsten filament	359
Nitrogen-filled lamp (estimated)	600

Mr. Lieb remarked that the central station has long since passed the period of showing fear at improvements in the state of the art, and now looks forward with cheerfulness and satisfaction to the introduction of more efficient lighting units as hastening the hoped-for day when electric light will be as accessible as kerosene in the humblest homes. Under competition with the new incandescent illuminant, the arc lamp, predicted Mr. Lieb, will itself shortly make rapid advances.

Mr. Fales pointed out that the telephone companies look to the new incandescent street lamps to replace arcs and thus to eliminate the "noise" troubles often caused by induction from humming in arc circuits.

In concluding the discussion Dr. Langmuir reviewed a number of the points brought up by the speakers. The greater brilliancy of the inner surfaces of the helix he attributed to cross reflection of light, rather than to reduced radiating aperture which, as he showed, could cause only 10 to 15 per cent difference. At very low pressures, uniform blackening deposits can be obtained on the glass, while convection currents are set up only at higher pressures. Dr. Langmuir expressed regret that his paper left the impression that he claimed to have been the first to attribute blackening to water-vapor causes, for this view, he said, has been held by others for many years. His own work, he explained, was intended only to demonstrate that all the other bulb gases are inactive and that water vapor is the only one to be feared.

As to the possibility of making nitrogen-filled lamps in small units, the speaker expressed doubt, although he expressed belief that beginning with the 500-watt size, or even smaller, the new lamps can be made in units ranging up to 25,000 or 50,000 cp, with ultimate efficiencies of possibly 0.3 watts per candlepower. Argon at higher pressures, he said, now holds promise of being a great improvement over nitrogen as a gas filler for incandescent lamp bulbs.

The results thus far obtained indicate that argon will be substituted for nitrogen in the lamps just as soon as the rarer gas becomes readily available on a commercial scale. Being one of the rare constituents of the atmosphere it is very difficult to produce in small quantities, but on a large scale it can be made very cheaply, comparatively speaking, and will, according to Dr. Langmuir, afford an improvement over nitrogen.

In the process of exhausting lamps, the author questioned whether the size of the constriction, however large, would have any effect on the completeness with which the water vapor is removed, unless a high temperature is maintained at the same time. On account of their heavy filaments the new lamps, he explained, are quite free from showing frequency flicker, even at 25 cycles.

The pressure at which the present "half-watt" lamps are filled with nitrogen—about two-thirds atmosphere when cold—was selected, said Dr. Langmuir, so that when hot the internal pressure becomes just about that of the atmosphere. No advantage would be gained by using higher pressures, which would only increase the likelihood of lamp explosions accompanied by outward-flying glass particles. The new lamps have proved to be extremely stable, he added, none having been broken in handling or shipment. In closing the author paid a generous tribute to the work of Dr. W. R. Whitney of the laboratory staff.

Central Station Management

Devoted to Discussion of Administrative Policies, Commercial Methods, and Current Practice Among Successful Utilities

Toronto's Vehicle-Charging Rate to Encourage Large Use

For electric-vehicle charging service the Toronto (Canada) Electric Light Company, Ltd., tenders a special rate which is designed to encourage larger use of customers' cars by rapidly reducing the equivalent cost as the monthly consumption of kilowatt-hours increases. The Toronto schedule begins with a rate of 5 cents per kw-hr. for the first fifty hours' use of the month's maximum demand, while for the second fifty hours' use the charge is but 1 cent per kw-hr. For all energy consumed beyond 100 hours' use of the maximum demand in any one month the rate is but 0.5 cent per kw-hr. On this basis the average return ranges from $10 to $12 per month per vehicle. At the present time 125 pleasure cars and twenty electric trucks are in use in Toronto.

Electric Operation of Pea-Viners in Michigan's "Cloverland"

Wallace, a community of eleven houses, two stores, two churches and a blacksmith shop, situated in the heart of Upper Michigan's "Cloverland" district, is probably the smallest village in the country receiving twenty-four-hour central-station service. Every house with one exception is lighted by electricity, energy being received over the 33,000-volt transmission line of the Menominee & Marinette Light & Traction Company from the latter's Menominee plant 16 miles distant.

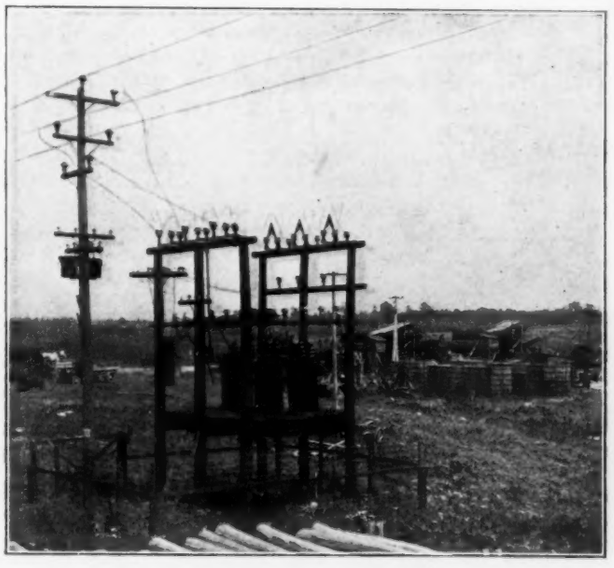


FIG. 1—OUTDOOR SUBSTATION AND ELECTRICALLY DRIVEN PEA-VINERS AT WALLACE, MICH.

But while Wallace may be the smallest electrically lighted town, its chief distinction is in having the largest electrically operated pea-vining plant in the world, which is right at the farmers' doors. Five pea-viners were in operation this season and the number will be increased to fifteen next year. During the 1913 season one of the canning factories alone bought $35,000 worth of green peas from the farmers of the vicinity. As one of the illustrations shows, the green-pea vines are hauled in to the viners at Wallace by wagon. After being threshed, they are then loaded into boxes without handling and are transported to a canning factory at Menominee by motor trucks, as depicted in the same illustration, which shows a familiar scene at Wallace during the canning season.

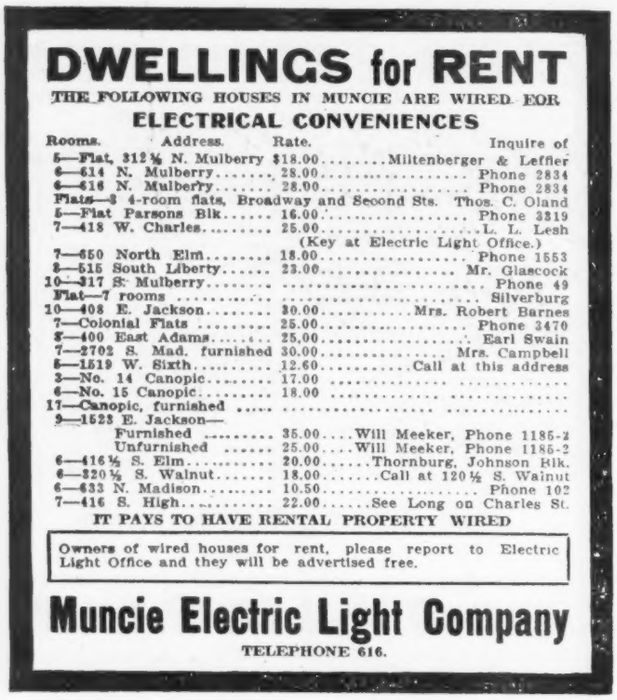
FIG. 2—ELECTRIC PEA-VINING PLANT OPERATED FROM CENTRAL-STATION 33,000-VOLT LINE

The electrical installation at Wallace comprises a bank of three 25-kw, 33,000/220-volt, 60-cycle, single-phase transformers, which, with the lightning-arrester equipment, are owned by the power company. There are two 20-hp, 220-volt, three-phase motors, each operating a pair of viners, and a 10-hp motor driving one viner. A rating of 7.5 hp per viner is considered ample, but the Michigan Refining & Preserving Company, which owns the plant, insisted on having abundant power capacity provided. The pea-vining plant was operated eight weeks during the season just closed.

The energy required by the vining machine varies with the yield and variety of peas, ranging from 166 watt-hr. for a 21-lb., twenty-four-can case of "Alaskas" down to 122 watt-hr for a case of "sweets." At 2.75 cents per kw-hr. the cost of vining an average case (144 watt-hr.) would therefore be 0.37 cent. One of these viners was operated by steam during a preceding season, and it is understood that electric drive has cost hardly half the outlay formerly necessary for engine operation. The chief reason for converting to electric drive was, however, the undesirable variation of speed inherent with the steam engine, which has been avoided with constant-speed motor drive. To shell peas properly, according to Mr. Edward Daniell, general manager of the power company, the viners must be run at a certain speed. If the speed is too slow some of the pods will not be opened, and if too fast the peas become bruised and are rendered unsuitable for canning. This matter of dependable, unvarying drive was, therefore, one of the principal considerations in giving up engine operation.

Advertising Wired Dwellings for Rent

As an inducement to the owners of rentable property to have all of their houses wired the Muncie (Ind.) Electric Light Company is displaying in the daily papers a list of the vacant wired properties. The advertisement is headed "Dwellings for Rent," below which is the statement that the properties listed are wired for electric service. In addition to the address of each house that is for rent there are given in the "ad"the rent per month, the number of rooms and the address or telephone number of the owner or real estate broker in charge. The owners of wired houses are requested to report vacancies at the office of the company so that the property may be listed in the daily advertising. At one time in the early spring months the number of vacant wired houses was reduced to four by this method of advertising, but, as will be seen, at the present it has increased



DWELLINGS for RENT

THE FOLLOWING HOUSES IN MUNCIE ARE WIRED FOR

ELECTRICAL CONVENIENCES

Rooms.	Address.	Rate.	Inquire of
5	Flat, 312½ N. Mulberry	$18.00	Miltenberger & Leffler
6	614 N. Mulberry	28.00	Phone 2834
6	616 N. Mulberry	28.00	Phone 2834
Flats	3 4-room flats, Broadway and Second Sts.		Thos. C. Oland
5	Flat Parsons Blk	16.00	Phone 3319
7	418 W. Charles	25.00	L. L. Lesh (Key at Electric Light Office.)
7	650 North Elm	18.00	Phone 1553
8	515 South Liberty	23.00	Mr. Glascock
10	317 S. Mulberry		Phone 49
Flat	7 rooms		Silverburg
10	408 E. Jackson	30.00	Mrs. Robert Barnes
7	Colonial Flats	25.00	Phone 3470
8	400 East Adams	25.00	Earl Swain
7	2702 S. Mad. furnished	30.00	Mrs. Campbell
5	1519 W. Sixth	12.50	Call at this address
3	No. 14 Canopic	17.00	
6	No. 15 Canopic	18.00	
17	Canopic, furnished		
9	1523 E. Jackson—		
	Furnished	35.00	Will Meeker, Phone 1185-2
	Unfurnished	25.00	Will Meeker, Phone 1185-2
6	416½ S. Elm	20.00	Thornburg, Johnson Blk.
6	320½ S. Walnut	18.00	Call at 120½ S. Walnut
6	633 N. Madison	10.50	Phone 102
7	416 S. High	22.00	See Long on Charles St.

IT PAYS TO HAVE RENTAL PROPERTY WIRED

Owners of wired houses for rent, please report to Electric Light Office and they will be advertised free.

Muncie Electric Light Company

TELEPHONE 616.

ADVERTISEMENT GIVING LIST OF WIRED DWELLINGS FOR RENT

owing to the building which has been done in the summer months. On account of the twofold results accomplished—that is, inducing owners to wire their property and keeping wired property occupied, so that it will be earning money for the company—the Muncie company deems it good policy to run the advertisement continuously and keep the list up to date.

Results with Central-Station Vehicles at Memphis

In its own service the Memphis (Tenn.) Consolidated Gas & Electric Company now operates five electric vehicles. Two are 1000-lb. Urban trucks with lead batteries, and the other three, all Detroit cars with nickel-iron cells, comprise a 2000-lb. truck, a 3000-lb. truck and a light roadster. In service over gravel-paved streets in moderately hilly districts these cars have averaged energy consumptions of 0.6 kw-hr. to 0.9 kw-hr. per mile traveled. The Urban trucks perform about 25 miles per day and the Detroits 40 miles per day. Repairs and maintenance have cost about 6.25 cents per mile, divided as follows: Batteries, 2.75 cents; tires, 2.5 cents, and car, 1 cent. The dependability of these electric vehicles and the fact that they are ready for service whenever wanted are points named by the local electric company in expressing its satisfaction with the use of these cars for its own city service.

Thirty commercial vehicles and 150 pleasure cars are also in the service of customers of the Memphis company, representing a monthly battery-charging output of 35,000 kw-hr. The rate for this service is based on a monthly charge of $1 per kw connected plus 3 cents per kw-hr. used. The average monthly consumption is about 170 kw-hr. for pleasure vehicles, and the corresponding central-station return is $8.20. For customers' electric trucks the consumption ranges around 800 kw-hr. and the monthly income is about $35.

Central-Station Energy for Ice Making

To the use of central-station electric energy for the operation of refrigerating plants hearty recommendation was accorded by several delegates to the third Western meeting of the American Society of Refrigerating Engineers held at Chicago during the recent International Congress of Refrigeration. Raw-water ice was the first subject up for discussion. Mr. H. D. Pownall, Canton, Ohio, declared his belief that electrically driven raw-water ice plants will be the final choice of all engineers in the future. Ice companies, he said, have a great opportunity to obtain desirable electric-service rates in the summer, when the outputs of central stations are low and the demand for ice is greatest. Electrically operated ice plants require less initial investment, less operating attention, a smaller depreciation allowance and less ground space. Cost of energy alone should not be the basis on which different motive powers are compared, since the interest on investment, the depreciation fund required and the amount of labor necessary must also be considered.

Mr. Louis Block, New York City, disagreed with Mr. Pownall on the practicability of using central-station energy, taken from the economic viewpoint, saying that it is cheaper to generate the energy at the ice plant.

In answer to this Mr. Pownall declared that he was ready to prove the economy of such operation to anyone who doubted it, as a number of plants erected by the Arctic Ice Machine Company, with which he is connected, have proved a financial success, operating on central-station energy. Electrically operated plants in New York built by this company are obtaining energy from the Brooklyn Edison company at 0.875 cent per kw-hr. This rate requires that the motors be kept off the lines from 4 p. m. to 8 p. m. during the winter months. Even if the electric-service cost were 50 cents per ton of ice manufactured against 20 cents per ton with steam or producer gas, Mr. Pownall insisted that it would often be found profitable to use central-station energy because of the elimination of large depreciation funds and interest on investment occasioned by the installation of isolated generating plants.

Mr. Thomas Shipley, of York, Pa., is a believer in distilled-water plants and said that people want pure ice. Remarkable results, he said, are being obtained in Germany, where 22 lb. of ice is being produced with 1 lb. of coal.

Such high economies, Mr. Pownall said, can be obtained only with distilled-water plants where multi-coil evaporators are used, and these involve heavy additional expense due to interest on investment and depreciation. He believes that raw-water ice lacks the peculiar taste of distilled-water ice. Furthermore, it is as pure as health authorities will likely ever require, since the impurities and bacteria are thrown off with the core water.

Mr. W. J. May said that the fuel cost in New York is from 50 cents to $1 per ton of ice manufactured, and that steam-driven plants cost from twice to three times as much to operate as motor-driven factories.

Mr. L. C. Nordmeyer, of St. Louis, gave a résumé of a paper delivered at one of the sessions of the Congress of Refrigeration, comparing the initial investment, interest,

depreciation and operating cost of plants equipped with simple and compound engines and with oil-engine-driven generators supplying energy for electric drive.

Dr. D. S. Jacobus, of New York, spoke of the possibilities of combining electric generating stations with ice plants, operating the latter during off peak periods to utilize the by-product distilled water and electric power.

Mr. A. S. Stahl, of South Bend, Ind., described an electrically operated ice plant in that city which employs the vacuum principle and is commercially successful. The first one of its kind was erected in Baltimore several years ago but proved a failure owing to lack of refinements. The one which he described is a 30-ton plant, but he intends increasing its capacity to 150 tons. The total cost of manufacturing the ice by this method, including interest, depreciation, labor and energy, amounts to 47 cents per ton.

The meeting closed with a discussion on the "flooded" type of ammonia condenser invented by Mr. Block, which is said to be proving successful. Mr. Peter Neff, of Canton, Ohio, presided at the meeting.

Formal Invitations to Brooklyn's Edison Shop

On Sept. 29 the Edison Electric Illuminating Company of Brooklyn, N. Y., held its first annual fall opening. News of the coming event was spread by mail among 5000 of the company's best residential and apartment-house customers by means of engraved invitations, one of which is reproduced herewith. For the occasion the Edison shop was decorated with artificial electrically lighted flowers and equipped with numerous household appliances ready to operate. Several manufacturers of heating and domestic devices supplied the services of women demonstrators for the day, so that no interested visitor lacked attention and all devices were shown at their best. A motor-driven piano furnished music throughout the reception except during the hours from 2 p. m. till 5 p. m., when the orchestra referred to in the invitation was in attendance. It was estimated that the number of visitors calling at the Edison Shop during the day was between 1500 and 2000.

The Edison Electric Illuminating Company of Brooklyn

Invites you to attend a demonstration of Electric Cooking and Heating Devices at the

Edison Shop

Three Hundred Sixty Pearl Street

On Monday, September the Twenty-ninth

From ten a. m. to five p. m.

The showing of goods electrical will be unusually interesting, including many new appliances that add greatly to the comfort of a modern home

A novel feature will be the first public demonstration of an electric fireless cooker which roasts, bakes, boils, steams, stews and fricassees—does anything any oven or fireless cooker can do.

Music, Two to Five Refreshments Electrically Cooked

FIG. 1—FORMAL INVITATION TENDERED TO CUSTOMERS

Among the many devices shown in the exhibit the new styles of lamp fixtures seemed to attract most attention. The extensive use of pressed brass in these fixtures has reduced the cost of manufacture so that they are within the reach of the family of moderate means. The demonstration of the electric fireless cooker was also of much interest to the women visitors.

FIG. 2—BROOKLYN'S EDISON SHOP READY FOR ANNUAL FALL OPENING

Monthly Consumption of Vehicles and Trucks

From the office of this journal inquiry blanks were recently sent out to central stations known to be doing a vehicle-charging business, replies being requested to questions concerning the monthly kilowatt-hour consumption of and monthly income derived from electric pleasure cars and commercial trucks. Tabulated herewith are some of the figures received, chosen from representative communities of various sizes in widely separated sections of the country. While the data obtained are not so complete as might be desired, the figures presented give a good idea of average conditions in this country. For example, the table reveals an average kilowatt-hour consumption for pleasure vehicles of 169 kw-hr. per month. The average rate earned per kilowatt-hour is 4.15 cents, and the average central-station income per car per month is $7.01. For electric trucks the average monthly energy consumption is 980 kw-hr., and the average monthly income per truck is $33.18.

ENERGY CONSUMPTION AND INCOME FROM VEHICLES AND TRUCKS

City	Pleasure Vehicles			Commercial Trucks		
	Number in Use	Kw-hr. per Month	Monthly Income	Number in Use	Kw-hr. per Month	Monthly Income
Brockton, Mass.	25	135	$9.59	9	2180	$52.32
Columbus, Ohio	400	200	8.00	....	....	....
Denver, Col.	822	....	....	52	....	....
Memphis, Tenn.	150	170	8.20	30	800	35.00
Meridian, Miss.	2	97	4.85	....	....	....
Mobile, Ala.	39	264	10.56	1	208	....
Montgomery, Ala.	8	180	3.60	....	....	....
Muskogee, Okla.	30	....	7.00	10	....	....
Portland, Ore.	55	165	7.00	35	1000	20.00
Rochester, Ind.	2	....	....	2	750	30.00
Schenectady, N.Y.	14	100	5.00	1	716	....
Turner's Falls, Mass.	1	211	6.33	....	....	....
Worcester, Mass.	10	....	20.00	14	1200	28.60

Illumination and Wiring

Inverted-Magnetite Lighting at Dixon, Ill.

Since Sept. 17 the main street of Dixon, Ill. has been lighted by a permanent decorative installation of forty inverted magnetite-arc lamps carried on brackets on the steel trolley posts. The lamps are spaced at intervals of 100 ft. and are suspended at a height of 18 ft. above the

NIGHT ILLUMINATION AT DIXON, ILL.

pavement. Merchants and adjoining property owners defrayed the cost of installation, the city paying for the operation of the lighting at the rate of $47 per lamp-year. The lamps burn from dusk until 11 p. m. daily, and until midnight on Saturdays. The citizens of Dixon are now paying at the rate of $1.50 per capita for their street lighting. So pleased were the merchants with the new ornamental lighting that on the second day after the first installation of forty was turned on a subscription was raised for installing twenty-seven more. Dixon has a population of about 10,000 and is the headquarters for the Illinois Northern Utilities Company, which operates in over 4500 sq. miles of territory in Northern Illinois, as described recently in these pages.

Proposed Special Lighting for Monroe Street, Chicago

The Monroe Street Improvement Association has been formed in Chicago, and one of its objects is to bring about a private system of arc street lighting, similar to that in use on Dearborn Street and such as is proposed for Clark Street, all in the downtown Loop District. Mr. Herbert A. Seward is the consulting engineer. It is planned to install seventy-four multiple flame-arc lamps on Monroe Street for a distance of eight blocks between Michigan Avenue and the Chicago River. Some of the lamps will be attached to brackets on the tubular steel poles supporting the street-railway span wires. The lamps will be suspended 25 ft. above street grade and about 100 ft. apart. Estimating the cost from experience with the similar installation now in operation on Dearborn Street, the labor, material and wiring will cost about $180 a lamp, and the operating cost will be, including maintenance and electrical energy, about $33 per lamp per year. It is hoped to obtain electrical energy, through the city, from the Sanitary District of Chicago at cost, but inasmuch as the load on the hydroelectric system of the Sanitary District is rapidly approaching the total rating, there is some doubt whether electricity can be obtained from this source. If not it will have to be purchased from the Edison company.

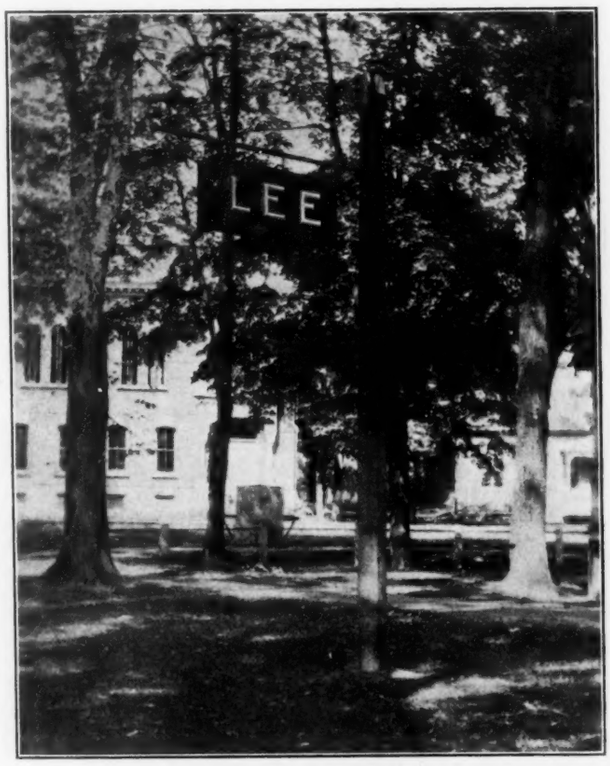
448 Search-Lamps for Panama Exposition Lighting

For the Panama-Pacific International Exposition, to be held at San Francisco, Cal., in 1915, there has been ordered the largest installation of electric search-lamps ever assembled. This equipment includes 48 36-in., 100 30-in., 200 18-in. and 100 13-in. projectors. The total effective spherical candle-power of these lamps numbers over 690,000, and the total beam candle-power is rated at 3,500,000,000. Even with such a large amount of light available, the general intensity of the light on the buildings will not exceed 2 ft.-candles.

For supplying the direct current required for the search-lamps two 1000-kw and two 250-kw motor-generators will be installed. The 250-kw sets will be three-machine units and will be used as balancers in addition to generating direct current for the search-lamps. In order to minimize the quantity of copper required to carry the heavy currents required by the projector lamps, the motor-generator sets will be installed in small substations located in the various exposition buildings.

Electric Sign for Town Identification

The use of electrically lighted billboards to advertise the commercial advantages of municipalities has now become a common practice. Less attention has, however, been given to the placing of electric signs on routes frequented by automobilists for the purpose of setting forth the names of communities. The accompanying photograph illustrates a sign of this kind erected a few days ago in the famous old Berkshire County town of Lee, Mass. The installation was made at the suggestion of a prominent selectman and has



LABELING A TOWN ELECTRICALLY

already brought results beneficial to hotel-keepers and business houses in the community. The sign is about 4 ft. long, 18 in high and 6 in. wide and is carried by a pipe-bracket arm. The wooden pole which supports it stands in the center of the town common, the lettering being about 12 ft. above the ground. The sign is operated all night long by the Lee Electric Company, six 40-watt tungsten lamps fur-

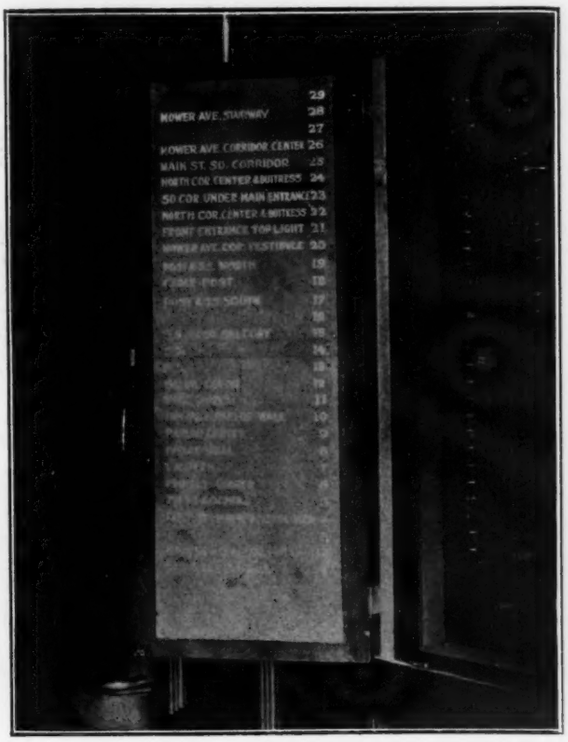
nishing the illumination. By the use of the raised electric letters the sign is equally useful by day or night and can be read from a rapidly moving automobile or interurban trolley car at a distance of over 100 yd. In a number of instances it caused travelers to interrupt their journeys and to spend several dollars before continuing their trips.

Reducing Tungsten-Lamp Breakage

The method which was used by some central stations and railroads in the early days of the tungsten lamp for reducing lamp breakage is now being applied with success to tungsten units on traveling cranes in steel mills. In many instances the lamps are suspended from the crane by springs. This precaution having been found insufficient, one operator bridged a 32-cp lamp permanently across the terminals of the knife switch controlling the crane lamps. In this manner the filaments of the lamps received enough energy at all times to heat them to nearly a dull red. Under these conditions tungsten is much more ductile than when it is cold and, of course, the breakages due to vibration of the crane are reduced to a minimum.

Improved Lettering in a Lighting Cabinet

In labeling the switches of lighting installations reliance is often placed upon mere typewritten lists of switch and circuit numbers in the wiring cabinets at important distribution centers, the result being that delays are caused on account of the difficulty met with in reading the labels. The accompanying photograph of a lighting cabinet in a New England church shows how this practice has been


MOWER AVE. STAIRWAY
MOWER AVE. CORRIDOR CENTER
MAIN ST. SO. CORRIDOR
NORTH COR. CENTER ABUTRESS
SO. COR. UNDER MAIN ENTRANCE
NORTH COR. CENTER ABUTRESS
FRONT ENTRANCE TOP LIGHT
MOWER AVE. COR. VESTIBULE

LEGIBLE LETTERING OF PANEL CIRCUITS

improved by the tabulation of the switch numbers and corresponding circuits in white painted letters, ¾ in. in height, on the slate panel of the box door. Manipulation of switches is greatly facilitated by such large legible letters, since the cabinet itself is in a dark hallway and is not provided with special illumination.

Letter to the Editors

Two-Phase to Three-Phase Auto-Transformer

To the Editors of the Electrical World:

Sirs:—In the issue of the *Electrical World* for Sept. 20 there appears on page 589, a description by Mr. Roy E. Uptegraff of a "two-phase, three-phase auto-transformer." At the end of the article in question credit for the devising of this method is given to Mr. William T. Taylor.

On page 962 of the *Electrical World* for Nov. 16, 1907, there was published a description of a similar method of connections for three transformers. This article also credited the method to Mr. Taylor as his invention and mentioned the fact that a patent had been issued to him on Oct. 29, 1907.

That this method of connecting transformers is not new, that it did not originate with the above-named gentleman and that it was not new at the time it was reported that a patent was issued is evidenced by the fact that the writer installed such a system of transformers and connections for supplying energy over the entire distributing system of the Central California Electric Company (now a part of the Pacific Gas & Electric Company's system) in the city of Sacramento in 1903. This system of both two-phase and three-phase distribution from four conductors was in continuous operation for nearly three years, after which time it was altered to a straight three-phase system and merged with the parallel system of the Pacific Gas & Electric Company (at that time the Sacramento Electric, Gas & Railway Company).

Originally the Central California Electric Company had a three-phase system with Scott three-phase, two-phase transformation through two transformers. In making enlargements and other changes new transformers of 300-kw rating were installed, there being two sets of three each. The identical connection above referred to was employed on the secondary (2400-volt) side, and the transformers were built and specified for this purpose. In operation both two-phase and three-phase motor and single-phase lighting circuits received energy from the four-conductor leads.

The development and use of the three-phase to two-phase, three-transformer transformation in Sacramento was the result of peculiar local conditions which might be of some interest historically. How far this method may have been known or used in 1903 I do not know. It is extremely simple and might easily have been developed by anyone who wished to work out various methods of phase transformation. Conditions in Sacramento were such that I desired to use three transformers which could eventualy be star-connected on the primary side when the line voltage should be raised. After deciding that there could be no objection to this method of connections, although I had never heard of such being used in actual practice, I made some inquiry to ascertain if it had ever been used, but could obtain no record of such use. I thereupon made specifications for the transformers. Two sets were ordered, one from the Westinghouse company and the other some time later from the Stanley company, the designs being quite different. The taps and ratios were the same, and the transformers operated in parallel about three years with the secondaries connected in the manner in question, the performance being quite satisfactory.

I have no doubt that Mr. Taylor, even as late as 1907, had not heard of the use of the arrangement employed at Sacramento, and hence thought the idea to be original with himself. I do not desire to enter into any controversy or in any way to depreciate Mr. Taylor's efforts toward the advancement of electrical science. I desire simply to state facts and if credit is due to anyone, let it go where it belongs.

San Francisco, Cal. Rudolph W. Van Norden.

Field of the Operating Engineer

A Record of Practice, Experience, New Ideas and Interesting Problems—Notes on Practical Subjects—Questions and Answers

Locating Grounds and Open Circuits on Series Arc Systems

A clear and simply worded account of the standard methods of locating faults, grounds and open circuits in the case of outages on series arc circuits was presented before the recent convention of the Michigan Section, N. E. L. A., by Mr. D. W. Hayes, Ann Arbor, Mich.

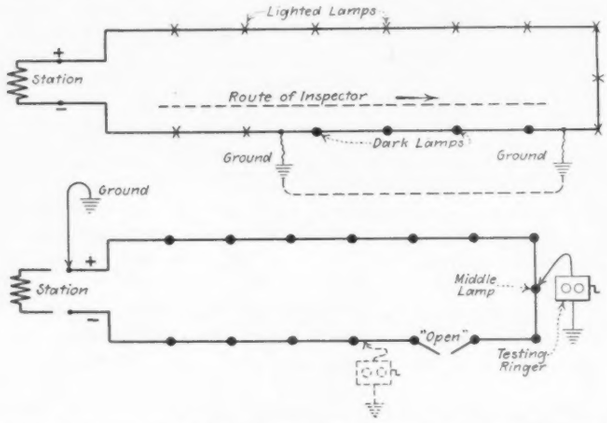


DIAGRAM OF CONNECTIONS FOR LOCATING DOUBLE-GROUND AND OPEN CIRCUITS IN SERIES ARC SYSTEMS

An "open," said Mr. Hayes, of course renders the circuit inoperative, extinguishing all lamps until repairs can be made. Two or more grounds will, on the other hand, put only part of the circuit out of commission. In case such a group of lamps is dark, the patrolman first tries one or more to see if current is flowing through them. If there is no current, the circuit is probably grounded in two or more places. The troubleman must then find the last lighted lamp in the circuit and the first one dark, and then carefully inspect the line between them, as one of the grounds must be between these two points. If the ground is in no immediate danger of causing damage, he then finds the last lamp out and carefully patrols the line from there to the first lamp burning. In this way he locates both grounds and can then remove them, clearing the circuit. If there are more than two grounds on the circuit, the others will show themselves as soon as the first grounds are cleared. They may then be located in the same way and cleared.

An open circuit shows itself when the short-circuit switch is opened at the station, an arc following the switch plug when the latter is pulled. The circuit is then tested with a magneto to find if it is actually open. If this is shown to be the case, the magneto test for open circuit is carried out. Circuit lists are provided showing each lamp on the circuit in its proper order. The positive side of the circuit is put to ground in the station and a tester proceeds to the middle lamp of the circuit, as shown by the list, and opens up the connection on the positive side of the lamp. He then tests to see if he can ring back to the station, using ground as one side of the circuit and the arc line as the other. If this circuit is complete, he knows that he has not passed the open and proceeds further in the circuit and tries again. In this way he finds a point from which the circuit is not complete to the station. He then goes back a short distance until he has a complete circuit. Working back and forth in this way, he narrows the possible location of the fault until it is possible to find it by inspection.

At Ann Arbor the trimmer patrols all circuits three times each week to replace burned-out tungsten lamps and to make a general inspection of the behavior of the arcs. He carries with him an insulated stool and rubber gloves, it being an inflexible rule that any man doing repair work without them on live arc circuits automatically discharges himself.

Switchboard Reconstruction at Milwaukee

Among the recent plant changes being made by The Milwaukee Electric Railway & Light Company are those at its Oneida Street generating station, which furnishes energy to the local direct-current district. Heretofore this plant has been handicapped from the operating standpoint by its switchboard arrangement. These panels were mounted in three tiers one above the other, the machine panel being on the main floor of the station, the lighting and motor-service feeders and battery panels on the first gallery, and the railway feeders on the second gallery. Under these conditions it was practically impossible for one switchboard attendant to operate all the equipment without considerable inconvenience.

As laid out under the new arrangement, however, all switching apparatus will be controlled from two positions instead of three. The railway board will remain where it now is while the machine, feeder and battery panels are to be combined in one board on the first gallery. Fig. 1 is a view of the new board from a recent photograph.

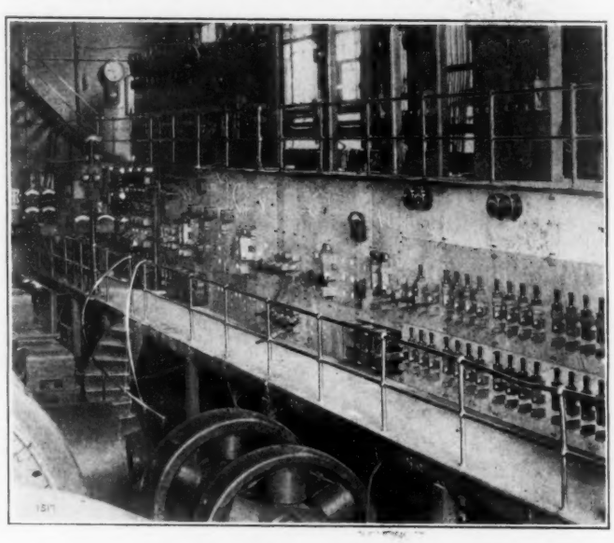


FIG. 1—FRONT OF SWITCHBOARD UNDER CONSTRUCTION

The new board is of marble and is a model of practical construction. It will have twenty-three panels when completed and will be 60 ft. 4 in. long. Two engine-driven 240-120-volt generators, three motor-generator sets, a balancer, two storage batteries and two booster sets will be controlled from the board.

Duplicate "high" and "low" buses are employed. Each main bus consists of five 10-in. by 0.25-in. copper straps in parallel. The feeder buses also have five straps in parallel, but they are only 5 in. wide. The bus structure on the switchboard, it is estimated, weighs about 6 tons.

Twenty inches of clearance is provided between the buses and the back of the board, so that the control and instrument wiring is not cramped for space and any repairs or additions which may be made in the future can be accomplished without danger to the wireman. The clearance space between the buses and the switch studs is bridged by jumpers made of heavy copper straps similar to that used on the buses. All control and instrument wiring is of slow-burning insulated wire.

FIG. 2—BACK OF SWITCHBOARD AT ONEIDA STREET PLANT, MILWAUKEE, WIS.

At each end of the switchboard behind the feeder panels each busbar is divided into two branches called the feeder buses, which allow two horizontal rows of feeder switches to be placed on each panel. The same clearance is left behind the machine panels. Because of the length of the jumpers connecting the buses with the switch studs very little vertical support is obtained from them. Horizontal angle irons are therefore placed at intervals under each bus, being supported at one end by brackets fastened to uprights which are insulated from the switchboard framework and from the marble floor. All of the railway feeders from the board on the second gallery are carried down the wall back of the switchboard in clay conduits set in concrete. Similar construction is used in the basement, where the cables run along the ceiling. The support for the ducts here consists of two rows of angle irons running parallel to the cables and supported from the ceiling by steel rods. Between the angle irons and at right angles to them steel rods are placed at intervals to support the ducts. When the work is completed all four sides of the duct-run will be plastered to give a finished appearance, the steel rods on the bottom of the run furnishing reinforcement for the plaster.

The switchboard installation has been done entirely by the Milwaukee Electric Railway & Light Company, the foreman on the job being Mr. P. G. Abraham. About thirty men have been employed in making the change, six of whom were wiremen, three were employed to bend copper straps for buses and the remainder were general electricians.

In addition to installing this new switchboard, the power plant department has completed erection of a new 500-hp Edge Moor boiler with a Jones stoker, which will be used to furnish steam for district heating. A machine shop has been added to the station equipment and will serve as a general power-plant machine shop for all of the stations. The other shops will not, however, be discarded. In the shop are both individual and group-drive machines. A shaper, two lathes, a drill press and a metal saw are driven from a single line shaft operated by a direct-current motor. A forge blower, sheet-metal rolls, grinder, two large drill presses and three pipe machines are driven by individual direct-current motors. Stockrooms are located above and below the machine shop.

Load Indicator for Boiler Rooms

Indicating wattmeters and various forms of load indicators are coming to be used in boiler rooms for informing the firemen of the amount of steam needed. A home-manufactured device of this kind in use at the Waterside station of the Louisville (Ky.) Gas & Electric Company possesses several additional features besides reading the load.

The accompanying illustration shows the indicating panel placed in the boiler room where it can be seen the entire length of the firing aisle. It consists of a rectangular case about 6 ft. high, 1 ft. wide and deep enough to hold the incandescent lamps which illuminate the translucent figures. The cover is hinged so that lamps may be replaced or inspected.

The lamps are connected to an operating switch in the switchboard room, which consists of a sliding contact handle which can be placed on any one of twelve buttons, besides bridging any two consecutive ones, if desired. Each button, of course, corresponds with a panel on the indicating board as shown in the diagram. In conjunction with the apparatus mentioned there is a return-call bell system. Located in the boiler room beneath the indicating device and also in the switchboard near the operating switch are three-way, flush-type push switches for operating the bells.

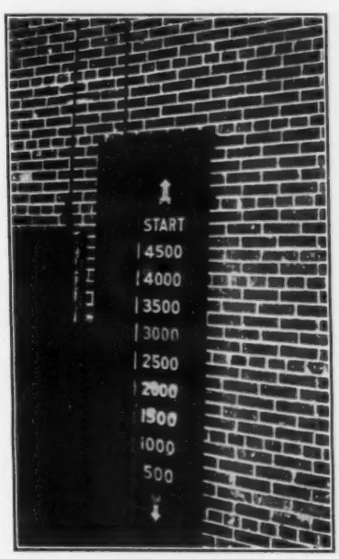


FIG. 1—INDICATING PANEL FOR USE IN BOILER ROOM

To indicate 250-kw fluctuations in load the switch handle is placed so as to bridge two buttons, thus lighting two lamps and indicating that the load is half way between the figures lighted.

If the switchboard attendant finds it necessary to start up an extra turbine, he moves the handle to the button marked "Start" for a few moments before he is ready to divide the

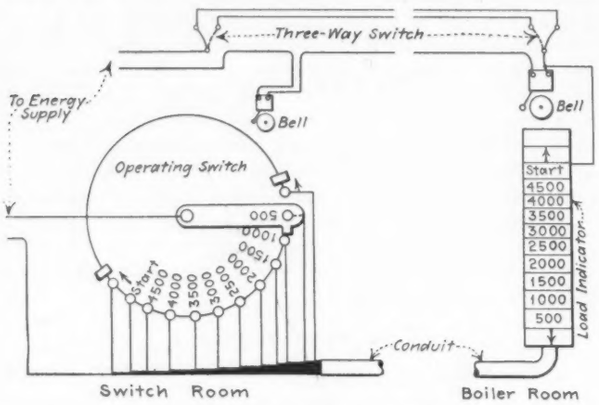


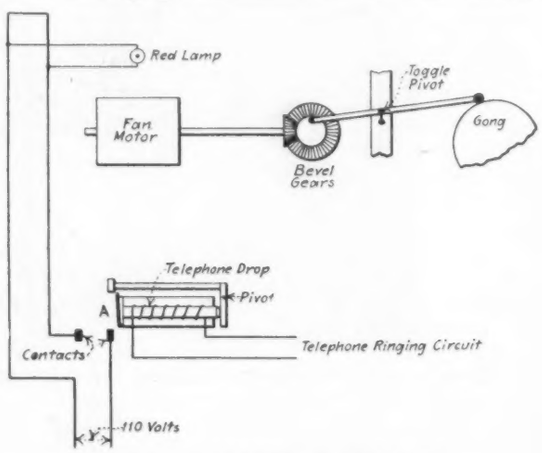
FIG. 2—CONNECTIONS FOR RETURN CALL BELL AND INDICATOR MECHANISM

load and then returns it to its normal position. The boiler-room attendant can then fire up an additional boiler if he finds it necessary or he can force the boilers already in operation so that they will be in condition to supply the additional steam to be required.

Sometimes the switchboard attendant fails to adjust the indicating apparatus when there is a change in load or the fireman thinks it is time for the load to change. When there is such doubt in the fireman's mind he presses the three-way push switch, previously mentioned, which lights up two arrows (similar to those on the boiler-room indicating device) on the switchboard attendant's signal board. The attendant at the board then either changes the indicator to agree with the load or else lights up one of the arrows in the boiler room to indicate that the load will soon decrease or rise.

Gong Attachment for Station Telephone

The unavoidable noise in a busy generating station makes it impossible for a telephone bell to be heard without some sort of loud-ringing attachment. A home-made device for



GONG ATTACHMENT FOR TELEPHONE

this purpose which is in operation in the generating plant of the Marion (Ind.) Light & Heating Company is shown in the accompanying drawing. An ordinary telephone drop is bridged across the ringing circuit of the station telephone and arranged so that a call entering the station releases the small metal piece shown at *A*. When this drop closes the gap between the contacts the fan motor is started and continues to drive the gong through the bevel gears until some person answering the telephone restores the drop to the upright position. A red lamp connected in the motor circuit also gives a visual warning. The scheme was worked out by Mr. O. M. Drischel, who is general superintendent of the Marion plant and it has been giving satisfactory operation since its installation more than a year ago.

Increasing Output of Boilers

Can boilers using anthracite coal be forced more readily than others? What is the simplest way to increase the steam output of such boilers? J. I. I.

The simplest way to increase the output of boilers under which low-grade anthracite coal is burned is to enrich the fuel by the addition of bituminous coal. By changing entirely from anthracite to bituminuous coal the boiler will give approximately double the output.

Regulation of Lamp Circuits

On one of our long circuits, the motor load has increased to such an extent as to affect the lamps burning on the circuit. Can the lighting service be improved without great cost? C. C.

It would be better to use separate transformers for the motor circuit because the variable load on the motors produces a poorer regulation in the transformers than is desirable for incandescent-lamp operation. An automatic regulator can be attached to the single-phase circuit feeding the lamps. By the use of such a regulator lamp operation is possible from transformers feeding a motor load.

Scale and Corrosion in Boilers

We are having trouble with the formation of scale in our boilers and would like to have you outline methods for its prevention. Are waters which produce scale also ordinarily corrosive in their action? L. H. F.

In the case of small plants where the outlay necessary for equipment to purify the water before it enters the boilers, cannot be justified, various compounds introduced directly into the boilers will often produce good results. Sodium hydroxide or caustic soda, sodium carbonate or soda ash, sodium fluoride, trisodium phosphate, tannin compounds, etc., combine with the scale chemically, converting it into compounds which are thrown down as soft sludges. On the other hand, organic materials, either gelatinous, as ground bones, hoofs, and horns, or starchy, as potatoes, slippery elm, etc., act mechanically on the precipitated scale, entraining it before a permanent hard scale has been formed. The quantity of compound to be used in any case can be properly determined only by chemical examination of the water supply, a fixed definite proportion of solution of known strength being delivered into the feed water as it enters the boiler. Blowing off the sludge should always be performed while the boiler is under low pressure, or if full pressure is on, the blow-off valve should be opened only slightly. The reason for this is clear. If the valve is opened wide under high pressure, the resulting rapid flow of water will scour only a narrow opening through the sludge, removing but little of that which would otherwise be carried off if a larger slow-moving stream were set up. As intimated, waters are sometimes both corrosive and scale-forming, for corrosive waters usually contain scale-producing ingredients. Such corrosive action can be neutralized by adding caustic or carbonate alkalis, like caustic lime, although these reagents themselves introduce serious scale-forming properties if not administered with great care.

Digest of Current Electrical Literature

Abstracts of Important Original Articles Appearing in the Periodical Electrical Press of the World

Generators, Motors and Transformers

Short Heat Tests of Electric Machines.—W. R. COOPER.—A paper read before Section G of the British association. Theoretically, if heat is applied at a constant rate to a body its temperature will rise according to a logarithmic curve such as that in Fig. 1. Here the temperature is shown rising at a rate depending on the rate at which heat is supplied and upon the thermal capacity of the body, so that the tangent to the temperature curve at the origin is a line such as OA. As the temperature increases, however, the body begins to radiate heat more rapidly, so that the temperature will then continue to rise more slowly. The loss by radiation or otherwise increases until the rate of loss equals the rate at which heat is supplied, and the temperature then remains constant; in other words, the curve becomes asymptotic to the line BC of maximum temperature rise. The curve being logarithmic, as expressed by the equation $T = T_{max}\,(1 - e^{-at})$, where T is the temperature and t the time, it follows that after a certain time, OD, dependent on the nature of the body, the temperature rise is equal to 63 per cent of the maximum. This time OD is conveniently called the "thermal time constant" and is the reciprocal of the quantity a in the above equation. Short heat tests depend for their accuracy on the extent to which the temperature curve follows the logarithmic law. The simplest graphical method is due to the fact that the sub-tangent of a logarithmic curve is constant. Thus, in Fig. 2, if ordinates are erected at points P_1, P_2, P_3, on the curve, then $A_1B_1 = A_2B_2 = A_3B_3$, etc., if the line A_1B_3 is the asymptote—that is, if it is the line of maximum temperature rise. The position of the asymptote is perhaps most easily judged by drawing several tangents at equal time intervals and noting on a scale the position where the intercepts B_1B_2, B_2B_3, etc., are all equal. Every sub-tangent (being equal to AB in Fig. 1) is theoretically equal to the thermal time constant. The slope of AO, or the tangent of the angle AOD, gives the initial rate of heating, and equally the rate of cooling when the temperature stationary point is reached. It is rather more convenient, perhaps, to regard

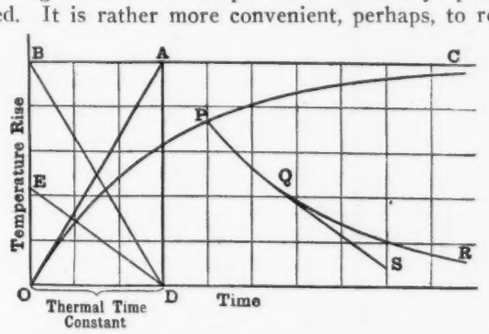


FIG. 1—CURVE SHOWING THEORETICAL TEMPERATURE RISE WITH HEAT APPLIED AT A CONSTANT RATE

BD as giving the final rate of cooling. The rate of cooling for any rise OE is then given by the tangent of ODE, which is proportional to OE. Consequently half the maximum rise is proportional to the rate of cooling at a rise of $\frac{1}{2}\,OB$, or at half the maximum rise; and thus, if the temperature rise T is found at which the rate of temperature rise (which is then equal to the rate of cooling) is half that at starting, the maximum temperature rise will be $2\,T$. This is the suggestion made by Prof. S. P. Thompson. Information is also readily obtainable from the cooling curve. Suppose the heating is stopped at a point P. The body will then proceed along a curve PQR. Let a point Q on this curve be taken at the same temperature as E, that is, on the same abscissa. Then the tangent QS will be

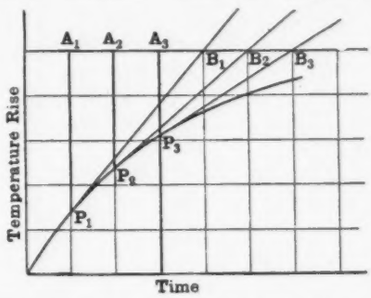


FIG. 2—CURVE WITH SUBTANGENTS SHOWN EQUAL

parallel to ED, because the slope of ED gives the rate of cooling at this temperature rise. Consequently the thermal time constant OD is at once obtained by drawing a tangent at a point on the cooling curve and then drawing a line parallel to this through the corresponding point E on the temperature rise axis so that it cuts the time axis. It also follows, since the curve of cooling is logarithmic, that if the temperature rise of a cooling body is T, the rise will fall to 37 per cent of T after an interval equal to the thermal time constant. Thus this important quantity can be found, at least theoretically, by taking any point on the cooling curve and finding when the necessary temperature drop has been reached. Several formulas based on such methods are given. Of course, short heat tests will not be practical unless the apparatus tested is of such a nature that it behaves like the machine in the assumptions. Transformers do not behave in this way, but field magnet coils do follow a logarithmic curve pretty fairly, and as the temperature of the field is frequently the temperature which limits the output of a generator, it appears that such tests might possibly be applicable to machinery of that class. The author describes tests which he has made with a protected direct-current dynamo, paying special attention to the determination of the thermal time constant because it is independent of the rate of heating and so allows one test to be compared with another. The results are given in tables and diagrams. For machines of this class a fair approximation can generally be obtained by testing for a period equal to about one and a quarter to one and a half times the thermal time constant, but the results are liable to vary. The best procedure seems to be to determine the thermal time constant from the cooling curve as the time taken for the temperature rise to fall through 37 per cent of any of its values. An ordinate is then erected at this time from the origin of the heating curve. The point where the heating curve is cut is then 63 per cent of the maximum temperature rise.—London *Electrician*, Sept. 19, 1913.

Lamps and Lighting

Arc-Lamp Electrodes.—A note on a recent British patent (10,210, 1913) of J. Roubal. The electrode has high emis-

sity, and is not easily oxidized when burnt in an inclosed, but not air-tight, lamp. The carbon, before or after pressing, is impregnated with a mixture of sodium or potassium, aluminum phosphate and graphite containing earthly admixtures. Preferably, also, baked calcium saccharate is added to the core.—London *Elec. Eng'ing*, Sept. 4, 1913.

Metallic-Filament Lamps.—A note on a recent British patent (14,048, 1913) of the Allgemeine Elektricitäts Gesellschaft. To improve the efficiency of metallic-filament lamps a substance capable of giving off oxygen at a low pressure when the lamp is burning is introduced in the bulb before exhaustion. Suitable substances are oxides, peroxides, nitrates, nitrites, chlorates, perchlorates, chromates, bichromates, etc., but manganese superoxide and barium chlorate are found specially suitable. The only reaction product is tungsten trioxide, which is practically colorless, and even when deposited on the bulb cuts off but little light. As it is non-volatile, no increase in pressure takes place in the lamp.—London *Elec. Eng'ing*, Sept. 4, 1913.

Sealing-in Lamp Leads.—A note on a recent British patent (23,775, 1912) of the British Thomson-Houston Company and the General Electric Company of this country. The leading-in wires are provided with a coating of metal, the oxide of which is soluble in the surrounding glass at a relatively low temperature, the compound wire having substantially the same coefficient of expansion as the glass. —London *Elec. Eng'ing*, Sept. 18, 1913.

Generation, Transmission and Distribution

Rheinfelden.—E. Frey and O. Albrecht.—A continuation of their illustrated detailed description of the Wyhlen power plant at the Rheinfelden transmission system. Details are given of the turbines, the generators and exciters, and the switchboard arrangement. There are ten generators, the pressure being 7000 volts, the speed 107 r.p.m., and the frequency 50. The rating of each generator under normal conditions at a power factor of 0.8 is 2600 kva. The maximum temperature rise of any part of the generator above the surrounding air is not above 45 deg. C.—*Elek. Zeit.*, Sept. 25, 1913.

Use of Oxygen with Diesel Engines.—A report by G. S. Taylor, British Inspector of Factories, on the causes of an explosion of a Diesel engine in a British electric station. As the accident happened, there had been considerable loss of air from both the blast vessel and the starting vessel of the engine in question, so that the pressure was insufficient for starting on the day of the accident. Acting in accordance with instructions issued by the makers, the engineer obtained a cylinder of oxygen from a firm of chemists, and by this means raised the pressure in the blast vessel to a normal figure, and also raised the pressure in the starting air vessel to some extent. By so doing, the air in the blast vessel became enriched so that oxygen was present to the extent of about 68 per cent. The engine was then started up, but almost as soon as the starting lever was put over to the "running" position an explosion appears to have occurred at the fuel valve on the cylinder, a blue flame was seen to travel along the blast pipe to the blast vessel and the latter exploded wih great violence and fatal results. The report discusses four alternative possibilities, and reaches the conclusion that the explosion of the blast vessel was caused by an oily deposit on its interior, and that ignition was transmitted by a flame explosion from the fuel-valve casing passing along the blast pipe. One of the final recommendations is that "compressed oxygen, on account of its intense chemical affinity, and combustible gases like hydrogen should not be used for the purpose of recharging air vessels, and a warning to this effect should be issued by the makers of Diesel engines."—London *Electrician*, Sept. 26, 1913.

Traction

Recent Progress in Electric Traction.—The complete issue of 110 reading pages gives an account of recent progress in several important branches of the electric-railway industry. The first chapter deals with modern methods of installing track in paved city streets. A chapter on power generators and transmission follows with reference to the continuous increase of the rotative speeds and corresponding in rating of electric machinery. In the substation the introduction of commutating poles for rotary converters has not only made the use of 60-cycle energy a possibility, but has developed machines of such capacity and reliability as to obviate the necessity for storage batteries to reduce peak loads. Then follow chapters on the design of city cars, repair-shop design and operation, fare accounting, transportation of freight, electric-railway signaling, and self-propelled cars.—Annual convention number, *Electric Railway Journal*, Oct. 4, 1913.

Electric Traction.—G. Kapp.—His presidential address to Section G of the British association. The advantages of the various systems of electric traction, three-phase, single-phase and continuous current are first dealt with, some details being given of lines which have actually been electrified on one or the other of these systems. Figures with regard to electric traction on main lines of the Italian State Railways are set out, while some information about the St. Gothard line is also given.—London *Electrician*, Sept. 12 and 19, 1913.

Installations, Systems and Appliances

Apparatus on Hire.—T. C. Parsons.—While some think that electrical apparatus should not be hired out by a municipal station but should be left to private traders, the author discusses at some length the advantages of the hiring scheme for municipal stations. He first takes up motors and discusses in great detail the organization of the hiring department, special features, application forms, account forms, etc. He finally takes up electric heating.—London *Elec. Review*, Sept. 12, 19 and 26, 1913.

Wires, Wiring and Conduits

Rapid Calculation of Overhead Lines.—A. Blondell.—In a continuation of his long illustrated serial on this subject the author discusses his new graphical method and its advantages over his former method. He shows that the use of one or the other is rather a matter of personal choice and explains in detail how both may be combined. He then discusses the overload coefficient as a function of diameter and wind.—*La Lumière Elec.*, Aug. 16, 1913.—In the conclusion of his serial the author indicates the corrections of elasticity and expansion which must be applied in practice in the use of his graphical method in cases where the assumptions made as to elasticity and expansion of the metal are not exactly fulfilled. He then shows the rational procedure in making a transmission line calculation and finally indicates the simplest method for determining the height of the poles.—*La Lumière Elec.*, Aug. 23, 1913.

Electrophysics and Magnetism

Range and Ionization of the Alpha Particles in Simple Gases.—T. S. Taylor.—An account of an experimental investigation in which the ranges of the alpha particles from radium C and polonium were determined by the scintillation method in helium, hydrogen, oxygen and air. The rate at which the number of alpha particles from radium C diminishes near the end of the range was determined by the scintillation method in air, oxygen, hydrogen and helium. The Bragg ionization curve was determined in helium and compared with the air and hydrogen curves obtained when the range of the particle was the same as that in helium. The ionization curve is of the general form

$$I\,(r-x)^{1/2} = c,$$

where I is the ionization, c a constant depending upon the energy required to produce an ion, r the average range, and

x the distance from the source of rays. The ratio of the total ionization in helium to that in air or hydrogen is 1.05. —*Philos. Mag.*, September, 1913.

Distribution of the Active Deposit of Actinium in Electric Fields.—H. P. Walmsley.—An account of an experimental investigation in which it is shown that the distribution of the active deposit of actinium between the electrodes in an electric field is independent of the concentration of the emanation. Actinium A acquires its positive charge in the process of its creation, and in all probability the electrical charge of actinium B has the same origin. As regards their electrical properties, both actinium A and actinium B behave exactly like the positive ions produced by their radiations. They recombine in exactly the same way, and the activity collected by the anode in an electric field is due solely to deposit atoms which have recombined. Under favorable circumstances recombination continues until the whole of the active deposit is electrically neutral. The anomalous behavior previously noticed was probably caused by the use of emanations containing active deposit and by dust-laden gases.—*Philos. Mag.*, September, 1913.

Mechanical Model of Coupled Oscillating Circuits.—E. W. Marchant.—An illustrated article describing a model for demonstrating some of the effects in coupled oscilating electrical circuits. The primary and secondary circuits in this model are represented by two oscillating pendulums.—London *Electrician*, Sept. 26, 1913.

Electrochemistry and Batteries

Lead Coating of Iron and Steel.—A note on a new process of Cowper-Coles for electrolytically coating iron and steel with a lead deposit up to 0.125 in. in thickness as protection against corrosion.—London *Electrician*, Sept. 26, 1913.

Units, Measurements and Instruments

An Electrical Instrument for Use in Graphical Mathematics.—An illustrated article pointing out the extreme delicacy and accuracy of "electrical touch" as applied to measuring machines, and describing as the first application of this delicacy and accuracy to graphical mathematics the "aphegraph"—an instrument designed by M. R. Guillery primarily for the investigation of inertia forces in moving parts, but equally applicable to any procedure involving graphical differentiation.—London *Elec. Review*, Sept. 26, 1913.

Motor Meters.—A note on a recent British patent (19,118, 1912) of S. Holden and Chamberlain & Hookham. Instead of employing solid brushes in direct-current motor meters of the eddy-current brake type, the armature spindle is inclined so that the commutator dips into mercury at its lower side. An open-coil winding in which one end of each coil is permanently connected to the armature spindle so that only one brush is required is used. Cupro-nickel is used for the commutator. An inclosed chamber is provided for the mercury, and arrangements are provided for expelling this when necessary. By means of floats attached to the spindle and immersed in a liquid, the weight on the pivots is reduced.—London *Elec. Eng'ing*, Sept. 25, 1913.

Telegraphy, Telephony and Signals

Telephonic Measurements.—A. Ebeling.—An illustrated description of the latest form of A. Franke's apparatus for the measurement of currents of telephonic frequency. The principle of the apparatus is described, together with the reasons of the latest improvements.—*La Lumière Elec.*, Aug. 30, 1913.

Fire Alarm.—J. Simey.—An illustrated description of a new fire alarm devised by Dafan. The novel features are the use of selenium, the device being actuated by light, and the fact that the alarm bell is set in action as the result of the opening of a circuit.—*La Lumiere Elec.*, Aug. 23, 1913.

Miscellaneous

Sensitiveness of the Human Skin as a Detector of Low-Voltage Alternating Emfs.—H. Stansfield.—A paper read before Section A of the British Association. On moving recently into a house with alternating-current supply for lighting at 200 volts' pressure, and a frequency of 50 cycles, the author found that the alternating emf could be detected by the vibration felt when the metal fittings carrying the lamps were lightly rubbed by the back of the hand. On substituting the ear for the hand, the vibration is heard as a musical note, but it is more convenient to rub with the hand and to employ a wooden stethoscope to detect the vibration of the metal. A paper punch connected to a live wire was generally employed, the end of the metal handle being rubbed by the observer's hand and the sound conducted to his ear from the wooden base by the stethoscope. Some variations of the experiments are described.—London *Electrician*, Sept. 26, 1913.

Ghent Exhibition.—Ernst Schulz.—An illustrated description of the electrical exhibits at the exposition in Ghent, Belgium.—*Elek. Zeit.*, Sept. 25, 1913.

Book Review

Shop Mathematics. Part II. Advanced shop mathematics, prepared in the extension division of the University of Wisconsin. By Earle B. Norris and Ralph T. Craigo. 214 pages, 218 illus. Price, $1.50 net. New York: McGraw-Hill Book Company, Inc.

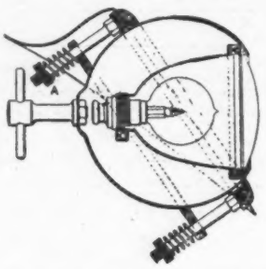
This volume presents the second half of the instruction papers in shop mathematics as developed and used in the extension division of the University of Wisconsin. The reader's knowledge of algebra, geometry and trigonometry is clearly assumed to be an almost negligible quantity, but after being introduced to the elements of these subjects he is gradually carried forward until—if he have properly assimilated the intellectual food here set before him—he should be able to apply with quickness and understanding any formula likely to be encountered in engineering workshop practice. More than this, he should be able to undertake an appreciable amount of intelligent calculation on his own account. The writing of a book such as this one, which obviously assumes the reader to be without the advantages of a university course or advanced technical training, is an extremely difficult task, and it is almost equally difficult to judge of the value of such books to the worker whose mind is not trained to follow the scientific or mathematical presentation of a subject. The authors, however, have had experience in teaching this course during a period exceeding five years, and the results have been satisfactory. They believe the book to be suitable for home study, and for this purpose it appears to be admirably adapted, seeing that the subject is clearly and systematically presented, the only requisites on the part of the reader being a mental equipment and tenacity of purpose capable of carrying him well forward in a subject not usually considered to inspire perseverance in its earlier stages. The book begins with an explanation of the nature and uses of formulas and the value of letters in representing physical quantities and numbers. Then follow the elements of algebra, the uses of curves in expressing equations and the derivation of equations from curves, geometric construction, areas and volumes. Four chapters are devoted to trigonometry and its applications, while the principle and uses of logarithms are explained in two short chapters at the end of the book. Many useful tables and formulas are included, and the examples used for illustration and for the application of the mathematical principles and formulas are in all cases carefully chosen and of special interest to the practical worker.

New Apparatus and Appliances

An Illustrated Descriptive Record of Recently Developed Manufactured Products of Interest to Electrical Readers

Orbicula Lantern for Automobiles

The accompanying illustration shows an interesting form of electric lamp for motor-car use recently brought out in France. It is known as the "eye" orbicula lantern and is the design of M. Cannevel, 14 Rue Reval, Levallois-Perret, near Paris. The lamp is of a type designed to be embodied in the body-work of the car, the feature being that it can at the will of the driver be turned in any direction, the socket being so arranged that it can be swept



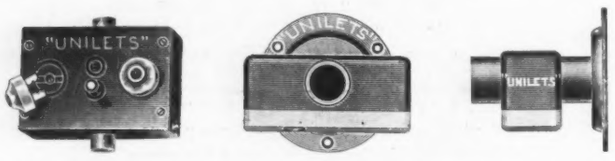
ELECTRIC LAMP FOR MOTOR-CAR

over an arc of 80 deg. both from left to right and up and down.

The lamp is held in any position by two small clamps which are removable from the inside and can be adjusted instantaneously so as to illuminate the signposts at the side of the road, milestones and even the motor in front. The entire lamp can also be pulled out of the socket and used to light the inside of the dashboard under the footboard and as a general trouble lamp. A slight loosening of the milled nuts, shown in the illustration at *A*, permits of turning the eyeball by means of the handle in any desired direction throwing the center of the beam where the strongest light is desired.

Conduit-Box and Bracket Fittings

The conduit-box fitting shown in Fig. 1 is a combination plug receptacle and push-button switch which is being made in units with one to three push buttons as desired. The boxes fit conduit of any size from 0.5 in. to 1 in. inclusive. Figs. 2 and 3 are respectively front and side views



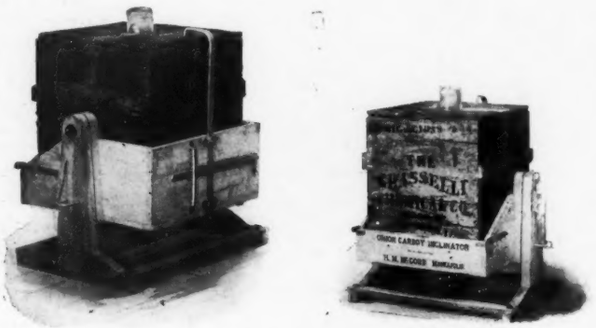
FIGS. 1, 2 AND 3—NEW CONDUIT BOX FITTING AND FRONT AND SIDE VIEW OF FITTING FOR PIPE LAMP BRACKETS

of bracket fittings for pipe lamp brackets, floor standards, and similar installations, where the conduit which is to be supported by these fixtures ranges between 0.5 in. and 1 in. in diameter.

All of these so-called "unilet" fittings are manufactured by the Appleton Electric Company, Chicago, Ill.

Carboy Inclinator

The improved carbon inclinator which is now being manufactured by Horace M. McCord, Minneapolis, Minn., provides an easy and economical means of pouring acid from carboys in central-station storerooms. The device



FIGS. 1 AND 2—INCLINATORS FOR POURING ACID

requires no more floor area for rocking or travel than would be taken by the carboy itself. The inclinator is built of spruce or hard pine and the 0.625-in. hanger bolts which carry the load bear on metal sleeves. An adjustable safety key prevents backward tilt. At the rear of the inclinator is an adjustable clamp rod which retains the carboy in position when it is tilted. All metal parts are painted black. The manufacturer states that the services of only one man are required for pouring fluid with this inclinator where otherwise two or three men are employed. The inclinator weighs 50 lb.

Sign Receptacle with Removable Screw Shell

By making removable from the front of the receptacle the screw shell which holds the lamp in place, the Arrow Electric Company of Hartford, Conn., has introduced another feature into its line of sign receptacles. With this

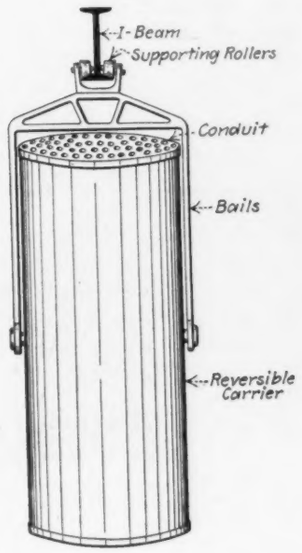
SIGN RECEPTACLE WITH REMOVABLE SHELL

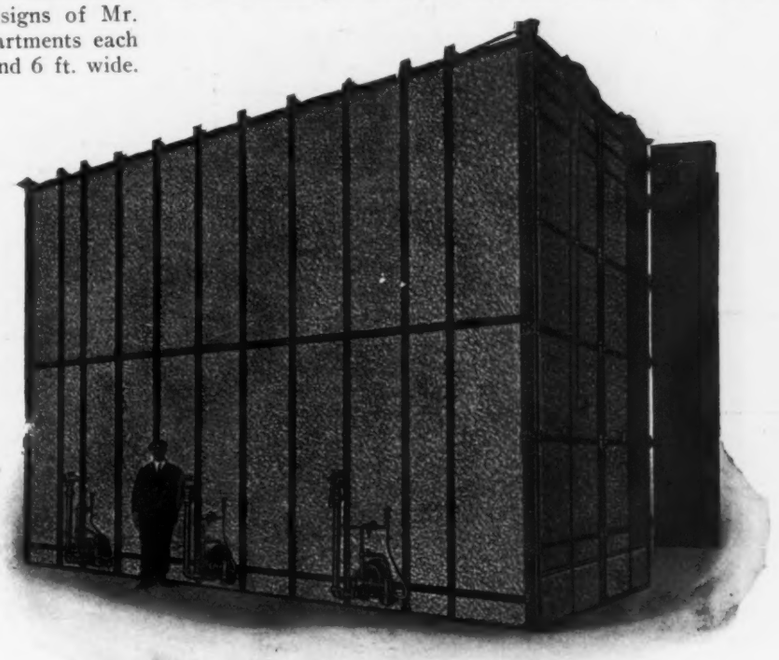
type of receptacle the screw shell may, therefore, be replaced if necessary without disturbing other parts or without removing the receptacle from the sign. The illustration presented herewith shows the method by which the shell is taken from the receptacle. This change in design has also been applied to all weatherproof outlet-box receptacles manufactured by this company.

GRIPPER AND SIDE GUIDE

Oven for Japanning Conduit

A conduit-japanning oven which is interesting not only by reason of the large amount of conduit which can be treated but also on account of the novel methods of handling the pipe is shown in the illustration. This oven, which was made by the Oven Equipment & Manufacturing Company, New Haven, Conn., from designs of Mr. Ronald Crawford, is divided into two compartments each measuring 30 ft. in length, 18 ft. in height and 6 ft. wide.





FIGS. 1 AND 2—CONDUIT CARRIER AND JAPANNING OVEN

The oven is capable of holding 86,000 lb. of material. The conduit is transported into and out of the oven on 15-in. I-beams in the center of each compartment. The doors fit these I-beams closely so that no heat is lost when the oven is in operation.

The conduit is manufactured in lengths of 12 ft. to 13 ft. and is japanned before being cut to lengths convenient for use. Heat is supplied by three inclosed-flame gas burners in each compartment. The ends of the burners in the left compartment are indicated in the illustration. By using air under a definite pressure from a positive pressure blower and regulating both the air and the gas, the temperature within the oven is easily maintained at any point which may be desired. Circulation of superheated air in the oven is assured by a pressure of about 1 lb. per sq. in. and by the natural draft through the vents at the top of the oven.

The sketch (Fig. 1) shows the method of handling the conduit, several hundred pieces, aggregating more than 7000 lb., being carried in each framework. The whole load, framework, conduit and all, depends from bails as shown, but runs on the I-beam mentioned. Six of these groups are placed in each compartment of the oven. When the time for complete baking has half elapsed the doors are opened and the loads of conduit run out, turned end for end and then returned to the oven where the process is completed. This method of treatment neutralizes any tendency there may be for the material to run toward the lower end of the conduit during the time that the raw japan is in the process of baking.

The temperature maintained in the oven is about 200 deg. Fahr. greater than was formerly used in steam-heated ovens designed for this purpose. New forms of japans have had to be developed to withstand this temperature, but the great advantage of using the intense heat lies in shortening the process, the saving in time being in some cases as much as 80 per cent.

Reversible Electrician's Glove

Much of the lineman's opposition to the use of rubber gloves has been due to the fact that they were difficult to work in. This objection has been in a large measure overcome by the Alliance Rubber Company, of Alliance, Ohio, which is making a soft, pliable, seamless glove of red rubber. These gloves are reversible and may be worn on either hand, eliminating the necessity of having individual "lefts" and "rights" Each pair is numbered, identifying them on a certificate of test which accompanies each set. This certificate guarantees the particular pair to withstand a specified voltage. The testing and checking is done by two individuals because no one man is infallible. The gloves are made in several weights. The lightest is guaranteed to withstand 1000 volts, another 4000 volts and a third 10,000 volts. The 1000-volt and 4000-volt gloves are tested to 150 per cent over-voltage and the 10,000-volt gloves are tested to 20,000 volts.

Thin Plate Batteries for Automobile Starting and Lighting

The thin-plate batteries made by the Baltimore Electric Storage Battery Company, Baltimore, Md., for automobile starting and lighting purposes, are assembled in hard-rubber jars encased in wood. Batteries for self-cranking motors are made with ratings ranging from 35 amp-hr. to 120 amp-hr. at 6 volts, 12 volts, 16 volts, 18 volts, or 24 volts. Lead-covered copper connectors and copper cores in the pillar posts reduce the voltage drop at the terminals,

FIG. 1—THIN PLATE BATTERY

and the rubber covering on the pillar posts prevents the creeping of acid and consequent corrosion of the connections.

The lighting batteries are of the 6-volt type and are manufactured in the following sizes: 60 amp-hr., 80 amp-hr., 100 amp-hr. and 120 amp-hr. All posts are brought up

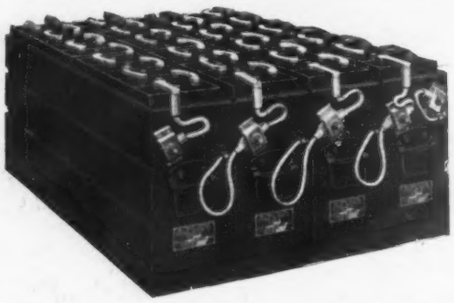
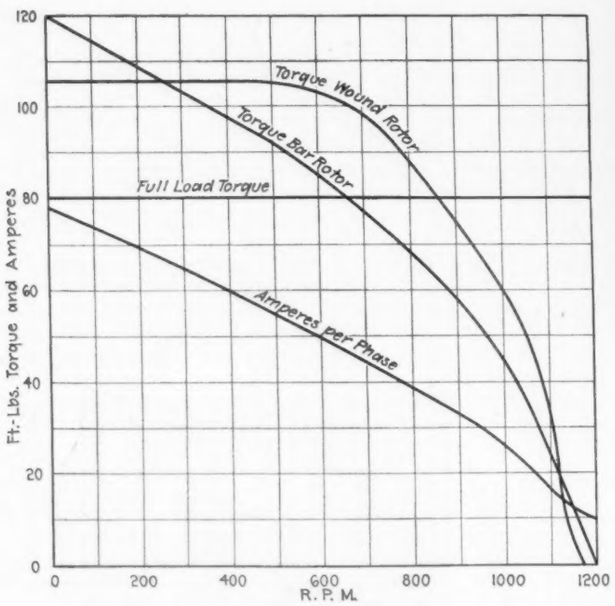


FIG. 2—BATTERY SHOWING END CONNECTIONS

through the cover so that any cell may be examined without disturbing the others. An over-flow chamber between the inside and outside battery covers catches the acid sprayed out during the charging period. It is stated that the active material used in these batteries and in the vehicle batteries of the company is specially pasted and formed to withstand the shocks and vibrations to which they are subjected in the operation.

Motors for Elevator and Hoist Duty

On account of special features in design of the squirrel-cage motors recently developed by the Lincoln Electric Company, Cleveland, Ohio, the starting current necessary to deliver a certain starting torque is explained to be from 5 per cent to 25 per cent less than would be the case with a slip-ring motor of the same rating. With an equal weight of iron and copper it has also been possible to obtain from

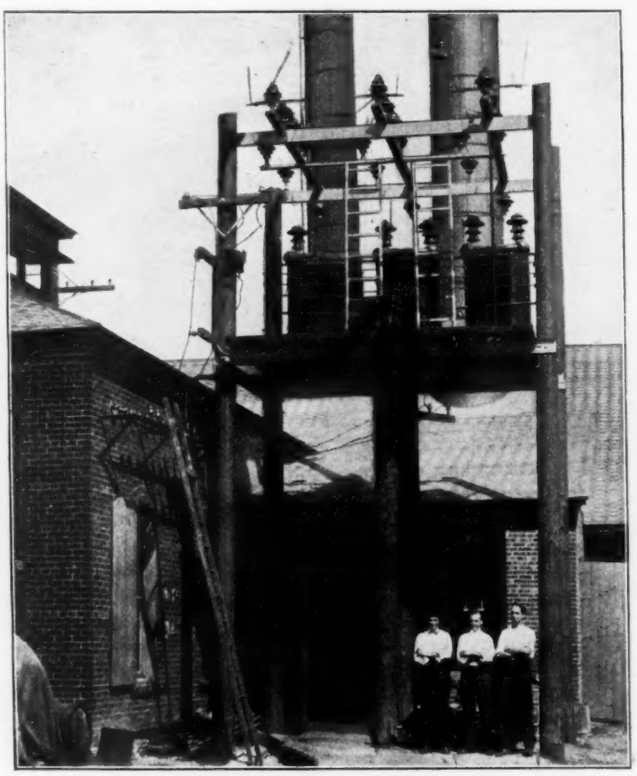


SPEED-TORQUE CURVES

10 per cent to 40 per cent more torque than could be delivered from a slip-ring motor. It is further stated that these machines will deliver twice full-load torque at current values not exceeding twice full-load rating. The manufacturers recommend these new squirrel-cage motors in sizes up to 25 hp for elevator and hoist duty except where low or variable speeds are maintained or where slow starting is required. The curve herewith shows for comparison the speed-torque curves of the slip-ring and the squirrel-cage motor.

A 300-kw. 33,000-Volt Outdoor Sub-Station

The outdoor sub-station shown in the accompanying illustration consists of three 100-kw, 33,000/2200-volt, 60-cycle transformers connected in delta. A three-pole air-break switch operated by a vertical rod, easily accessible from the platform, comprises the high-tension switching equipment. Fuse protection is secured by the use of chemical fuses easily reached by the two ladders, and protection against excessive voltage disturbances or surges is provided by adjustable discharge horn gaps. Between the discharge gaps and the transformers are located heavy inductors consisting of specially designed choke coils which serve to flatten out abrupt static waves or other disturbances. The choke coils reflect these surges back to the gaps, where they are quickly discharged to ground. When the gaps discharge the carbon-tetrachloride fuses are in series with the circuit to ground so that in case of abnormal current flow these fuses operate to prevent a local disturbance from affecting the main line.



OUTDOOR SUBSTATION

This particular installation is located outside of an old steam-driven plant which formerly supplied the small town in which it is located with electric lighting and motor service.

The 2200-volt circuits are carried into the building at the left and distribution made through a switchboard formerly used for the steam-driven plant. With this arrangement energy can be supplied from the 33,000-volt line, and the local generating plant can be shut down, or the local plant can when desired be used as a generating point feeding the main line through the outdoor substation. The apparatus shown in the illustration was furnished by the Delta-Star Electric Company, Chicago, Ill.

Industrial and Financial News

Public Utility, Commercial, Corporate and Trade Developments—The Electrical Material and Security Markets

Paying for Electric Wiring on the Instalment Plan.—Everybody is familiar with the instalment plan as used to boom the furniture business, but the application of this method of payment to electrical wiring work is decidedly novel. The Alexander M. Knauber Company, an electrical contracting firm doing business in and around Chicago, Ill., has recently issued a statement in which it offers to do wiring and the installing of electrical fixtures on an easy payment plan, which allows the customer two years in which to pay for this service.

Street Lighting Plans in Three Small Cities.—Among the small cities which have recently contracted for or increased the installation of "White Way" systems are Virginia, Minn., where 114 five lamp ornamental posts are to be supplied by the Star Electric Company; Lakeland, Fla., where Caldwell & Feighley are to furnish 50 posts of the same type, the top lamp being of 100 watt and the lower four of 80 watt rating; and Hagerstown, Md., where 35 three-lamp ornamental posts are to be installed by the Central Garage & Electrical Supply Company. The latter system is to be so wired that the lower lamps can be turned off at any desirable hour, leaving the top center lamp in each cluster burning. It is expected that this installation will be largely extended in the near future.

Westinghouse Company Receives Large Order for Generating Equipment.—For use in connection with the electrification of the Norfolk & Western Railway which has been previously announced, the Westinghouse Electric & Manufacturing Company has received orders for the following power station apparatus: three 9000 kw, 25-cycle, 11,000-volts, 1500 r.p.m., single-phase, turbo-alternators with two 150 kw 250-volt, turbo exciters and one motor generator exciter of the same rating; one 200 kva, 3-phase, 25-cycle, 11,000/440 volt transformer; three 1500 kva, single-phase, 25-cycle, 33,000/11000-volts auto-transformers and six 2500-kva, and four 3000 kva auto-transformers of similar characteristics; one 10 per cent reactance for the 11,000-volt feeder circuit and one type TA voltage regulator for the turbo-generators.

St. Paul Supply House to Build.—The Northwestern Electric Equipment Company, of St. Paul, Minn., announces that it has purchased land and awarded contracts for a new building to be erected for its own use on Sixth Street, between Jackson and Sibley Streets. The structure will be 50 ft. wide, 150 ft. deep and six stories high with a basement. It will have about 50,000 sq. ft. of floor space and its owners think that it will be the largest building west of Chicago, exclusively devoted to electrical machinery and supplies. The first floor will be devoted to city sales and to show rooms. The second will be used for general offices, while the basement and upper floors will be utilized for shops and storing goods. The company does a general supply business. F. B. Thompson is president, J. M. Whalen, vice-president, and A. J. Anderson, secretary.

Standard Catalog Numbers Wanted for Electrical Supplies.—A prominent electrical contractor in the Middle West has recently given expression to a sentiment which is doubtless shared by all in his line, and others whose work involves the investigation of manufacturers' pricelists and catalogs on electrical supplies. In large part each manufacturer has his own private method of indicating and numbering the various standard articles which he makes, such as cut-outs, sockets, switches, fuses and similar apparatus. Probably in each case the system adopted is admirably suited to the manufacturer's own business needs, but the result of the whole system is to bring the contractor, engineer or purchasing agent endless confusion in dealing with a chaotic nomenclature. This multiplicity of names and numbers for the same piece of apparatus is the thing to which the above mentioned contractor objects. Possibly a little special investigation and cooperation between manufacturers along the line of a standard listing system would prove of as much advantage to them and to the industry as a whole, as has the progress made so far in standardizing designs on these staple electrical supplies.

Gas Engines Sold for Electric Generator Drive.—The Northwestern Electric Equipment Company has recently purchased two 50 hp producer gas engines from the Bruce-Macbeth Engine Company, of Cleveland, Ohio, one for each of two installations of lighting generators at Volga and at La Moure, North Dakota. The latter company numbers among its larger recent shipments seven gas engines of 40 hp rating or over, aggregating 970 hp, in addition to the engines first mentioned. The biggest single sale reported is of two 300 hp producer gas engines for the Metropolitan Building, Philadelphia, Pa.

General Electric Apparatus in Demand for Power Plant Equipment.—Among the recent orders for generating and auxiliary power equipment received by the General Electric Company, of Schenectady, N. Y., the following are of special note. The Winooski Valley Power Company, Essex Junction, Vt., will add to its station equipment four 1500 kva alternating current generators, a 100 kw motor-generator, seven 1000 kva water-cooled transformers, switchboard and accessories. The Hannawa Falls Water Power Company, Potsdam, N. Y., will install additional electrical apparatus in its station consisting of a 450 kva alternating current generator, two 2000 kva water-cooled transformers and switchboard panels. At the Eagle Falls, N. Y., station of the Beaver River Power Corporation, Beaver Falls, N. Y., there will be placed in operation two 1500 kva alternating current generators with 26 kw exciters, three 1500 kva water-cooled transformers, switchboard and accessories. The Northern Power Company, Potsdam, N. Y., will add to the equipment of its station at Canton, N. Y., three 1000 kva water-cooled transformers and a switchboard. The Wisconsin River Power Company, Madison, Wis., will install a 2800 kva water-cooled transformer.

Bell Telephone System Under Fire.—Following the recent Government suit, started at Portland, Ore., against the American Telephone & Telegraph Company, charging violation of the Sherman Anti-trust Law by monopolizing the means of telephone communication between and within the states of Oregon, Montana, and Idaho, comes the announcement that complaint has been filed by the Postal Telegraph-Cable Company in Baltimore, Md., against the Chesapeake & Potomac Telephone Company, a subsidiary of the American Telephone & Telegraph Company, charging that it has diverted business from the Postal to the Western Union Telegraph Company, in which it has a financial interest. This latter action only echoes a similar complaint recently made in New York City, where partial relief was obtained by action of the Public Service Commission. It seems probable from all indications at this time that the Bell system will shortly be investigated by the Federal Department of Justice, to determine exactly its status under the present laws. Considerable attention has been paid of late to the question of government ownership of telephone and telegraph facilities and their operation in conjunction with the present postal system. This idea has grown to sufficient size to have found backing by the Postmaster General under the last administration and it certainly has some advantages from the standpoint of service. Whether or not it would be economically feasible at this time is another question, but in all events a detailed investigation of the operation of the present system will

probably throw much light on the subject. Rumors to the effect that confiscatory measures are proposed by the Government are too wild to be given any serious consideration and the fact that no fears of this nature are entertained by the American Telephone & Telegraph Company is shown by the recent statement of President Vail, in which he said that the company has little fear that the Government will attempt to take over the telephone and telegraph system of the country, except after long discussion, while any attempt to build up a government system to compete with the existing lines would be more expensive than to buy them up. A possible result of the present agitation is the complete divorcement of the American Telephone & Telegraph Company from the Western Union Telegraph Company, as far as finances are concerned.

Italian Electrical Manufacturers Plan Invasion of American Field.—Ercole Morelli & Company, electrical manufacturers, of Milan, Italy, have opened a temporary branch office and show room at 35 Broadway, New York, where they are showing a stock of standard alternating and direct-current oscillating fans, and also a line of motors of capacity from a fraction up to 250 hp, as well as a number of electrically driven centrifugal pumps for operation on either direct or alternating current and designed for varying pressures from 19 to 520 ft. The office is in charge of L. A. E. Frankel.

Surprising Sale of Refrigerating Machines.—It might be supposed that during September, after the worst heat of the summer had passed and there was every promise of an early winter, the sales of refrigerating apparatus would fall to a low figure. The York Manufacturing Company did a very good business during this period, however, and an aggregate capacity of nearly 750 tons in refrigerating machinery, besides a large amount of auxiliary equipment, was sold between Aug. 21 and Sept. 23. The largest single order filled in this time was for three 65-ton horizontal double-acting Corliss steam-driven refrigerating machines, a 90-ton flooded freezing system complete, a 100-ton distilling system, and a 400-hp boiler, all of which apparatus went to E. A. Keisewetter, of Homestead, N. J. Foreign sales included in the above aggregate figures were to the International Cold Storage & Warehouse Company, Ltd., of Southampton, England; Enrique M. Barrette, of Manila, P. I., and the Manitoba Agricultural College, Fort Garry, Manitoba, Canada.

Power Plant Installation for Railway Shops.—The National Transcontinental Railway Commission, in building the large general repair and locomotive shops at Transcona, Man., decided that the best interests of the railway, in economy, efficiency and reliability, could be served by the erection of a modern central power plant in which steam and electrical apparatus of sufficient capacity to supply the present demands should be located. This power house has been built and equipped throughout. The generating apparatus consists of 9 units with a total normal capacity of 2030 kw, 1600 kw alternating current and 430 kw direct current. The generators were manufactured and installed by the Canadian General Electric Company, and the Goldie & McCullock Company supplied and installed all engines. The units supplying the electrical power consist of three 500-kw alternating-current, 600-volt, 60-cycle generators, running at 150 r.p.m., each one directly connected to a horizontal cross compound, non-condensing Corliss engine; one 250-kw, alternating-current, 600-volt, 60-cycle, 150-r.p.m. generator and a 150-kw, direct-current, compound- wound, 250-volt, 150-r.p.m. generator, each directly connected to a simple Corliss engine. There was installed, also an auxiliary 150-kw motor generator set, consisting of a 225-hp, 900-r.p.m. induction motor directly connected to a 150-kw direct-current, 250-volt compound wound interpole generator. All the steam engines operate non-condensing, because their exhaust is required in the low pressure steam system for heating the shops. The generator switchboard was manufactured and installed by the Canadian Westinghouse Company, and consists of 21 blue Vermont marble panels, 7 ft. 8 in. high, and 2 in. thick, the entire board being 52 ft. long. There are 7 generator panels, 1 alternating-current totalizing panel, 1 direct-current feeder, 1 alternating-current general lighting, 1 arc lighting and 10 alternating-current feeder panels, the only special apparatus on the switchboard being the motor-operated rheostats with which each of the generator panels is supplied. As all the power and light distribution is underground, the necessary cables pass through 38 ducts in the east and west walls to the various buildings. The conductors between all generators and switchboards are rubber-insulated, lead-covered cables, run in iron conduits from the oil switches to generator terminals. All feeder circuits to the various buildings are paper insulated and lead covered, run in fibre or tile conduit. There is at present 2560 kw in motor and lighting load connected to this power plant, and this amount will be increased to approximately 4060 kw when the car shops are fully equipped. The low-load factor common in this type of shops still gives the power plant a reasonable margin for emergencies. The artificial lighting of both the engine and boiler rooms is performed by Cooper Hewitt type H mercury vapor lamps for general illumination, and incandescent lamps in the pump pit, pipe tunnel and in the boiler room basement. Extension cord receptacles are also located at various places in the building. This power plant was designed under the supervision of W. J. Press, mechanical engineer for the National Transcontinental Railway, and the construction was carried out under the direct supervision of D. A. Evans, assistant engineer.

Electricity and the Copper Industry.—The production of copper in 1912 by smelters in the United States was 1,243,268,720 pounds, valued at $205,139,338, the largest annual figures in the history of the industry. Of this amount about 29 per cent was smeltered in Arizona, about 25 per cent in Montana, and about 18.5 per cent in Michigan, the rest being divided between twenty-three other states and territories. It is interesting to note the extent to which electric energy has been applied to both mining and smelting operations. In California electric power is used almost exclusively in both the mines and smelters, and the mines of the Mammoth Copper Mining Company are connected with its smelter in part by an electric railroad. At the High Ore shaft of the Anaconda Copper Mining Company, in Montana, there are electric pumps in operation, an electric haulage system is being installed, and it is estimated that the use of electric power is materially reducing the cost of operation. Electric haulage was also installed on the lower levels of the North Butte mine, operated by the same company. During 1912 arrangements were completed for the substitution at the mines and mills of the Utah Copper Company, in Utah, of hydro-electrically generated energy for the steam power previously used. This electricity is to be furnished by the Utah Power & Light Company and it is expected that by the close of the present year the latter will be able to furnish the power for all operations. The refinery output of the United States during 1912 was made by 13 plants, 9 of which employ the electrolytic method and turn out a large proportion of the total copper produced.

NEW YORK METAL MARKET PRICES

	Oct. 7 Bid.	Oct. 7 Asked.	Oct. 14 Bid.	Oct. 14 Asked.
Copper:				
Standard, spot*	....	....	....	....
	Selling Prices		Selling Prices	
	£ s d		£ s d	
London, standard, spot*	73 7 6		70 10 0	
Prime Lake	16.75 to	16.87½	16.50	....
Electrolytic	16.50 to	16.60	16.15 to	16.25
Casting	16.25 to	16.37½	16.00 to	16.12½
Copper wire base	17.75	....	17.25	....
Lead	4.60		4.50	
Nickel	40.00 to	45.00	40.00 to	45.00
Sheet zinc, f. o. b. smelter	7.75		7.75	
Spelter, spot	5.45 to	5.55	5.35 to	5.45
Tin, spot	40.35 to	40.60	40.25 to	40.45
Aluminum:				
Prompt delivery	20.00 to	21.00	20.00 to	21.00
Future	20.00 to	20.50	20.00 to	20.50

***OLD METALS**

Heavy copper and wire	15.00	15.00
Brass, heavy	9.75	9.75
Brass, light	8.50	8.50
Lead, heavy	4.50	4.50
Zinc, scrap	4.75	4.75

***COPPER EXPORTS**

Total tons to Oct. 14	12,321

*From daily transactions on the New York Metal Exchange.

Corporate and Financial

American Telephone & Telegraph Subsidiaries Issue Short Term Notes.—The American Telephone & Telegraph Company has recently endorsed and sold through J. P. Morgan & Company and Kidder, Peabody & Company, $10,000,000 in six months' notes of some of its subsidiary companies. The loan cost the company about 5½ per cent per annum, since interest was discounted in advance.

Organization Changes in the Alabama Power Company.—In connection with the resignation of W. W. Freeman, former vice-president and general manager of the Alabama Power Company, the principal subsidiary of the Alabama Traction, Light & Power Company, it is announced that Mr. Freeman will retain his membership in its board of directors as well as in those of the other American properties in which Sperling & Company, of London, are interested. Frederick Darlington, a director and vice-president of the Alabama Power Company, is giving considerable time to the commercial end of the company's business and has greatly increased the size and scope of the new business department.

Electric Traction Finances in New York City.—The summary of reports of street railway companies, operating in the city of New York, for the quarter January to March, inclusive, has just been issued by the Public Service Commission for the First District. Some of the totals are of interest as indicating the size of the traction problem in that city. There are 36 separate companies involved in the system. The total revenue car miles amounted to 78,876,156 and 434,329,530 fare passengers were carried. The total operating revenue for the above period was $22,354,855 and the total operating expenses were $12,141,352. The gross income on these properties amounted to $9,763,506, and the net income amounted to $2,464,396. The total liabilities of the companies comprising this immense traction system aggregate $601,040,557.

Commonwealth Edison Company Increases Dividend.—Supplementing the note in the Sept. 13 issue of the *Electrical World*, in which it was stated that the director of the Commonwealth Edison Company had virtually determined on making that an 8 per cent stock, it is now learned that definite action in this direction was recently taken when the quarterly dividend, payable Nov. 1 to stockholders of record Oct. 18, was declared at 2 per cent, instead of the previous figure of 1¾ per cent, thus changing the annual dividend rate from 7 to 8 per cent. The announcement of this dividend increase, following so soon after the control of the People's Gas Light & Coke Company passed into the hands of the Commonwealth Edison interests, seems to indicate that the properties, which combined dominate the power and lighting industry in Chicago, are in a strong financial condition.

Merger of Atlantic Gas & Electric Subsidiaries Planned.—The directors of the Eastern Pennsylvania Power Company have approved a plan to consolidate that concern with the Pennsylvania Utilities Company, forming a new Pennsylvania Utilities Company with a capital stock of $1,000,000 common and $1,000,000 preferred. At the present time the Eastern Pennsylvania Power Company has outstanding $4,500,000 stock, of which $3,500,000 is common and $1,000,000 preferred, and the Pennsylvania Utilities Company has $85,000 stock outstanding, which is controlled by the former company. A considerable scaling down of stock will be necessitated by this move, and it is announced that the stockholders of the power company will hold a meeting on Oct. 25 to vote on the proposition and to determine the rate at which the old stock will be exchanged for the new. The Atlantic Gas & Electric Company controls the Eastern Pennsylvania Power Company through stock ownership.

Pacific Light & Power Corporation Matters.—It is expected that the Big Creek hydro-electric development with its initial capacity of 66,000 hp will be in partial operation by Jan. 1, adding materially to the earning power of the company. While the interest charges on the $10,000,000 5 per cent first mortgage and refunding bonds and the $2,500,000 of 6 per cent one year notes issued in connection with this development are being charged against construction account, the earnings of the company for the year ending Aug. 31 were sufficient to care for this interest in addition to that on the other bonds of the company. Gross earnings for that period were $2,772,732, and the net earnings were $1,244,751, out of which was paid $469,561, leaving a balance of $775,189, more than enough to pay the interest on the securities issued in connection with the Big Creek development. The company's operating expenses increased $170,829 over the figures for 1912, but this item is expected to show a material decrease comparatively, as soon as the new hydro-electric stations get into operation.

Interborough Rapid Transit Bond Issue.—The Interborough Rapid Transit Company, of New York City, is offering through Lee Higginson & Company, Harris Forbes & Company, Kissel Kinnicutt & Company, W. A. Read & Company, and White Weld & Company, at 98½ and interest, $30,000,000 of first and refunding mortgage 5 per cent gold bonds. These bonds are dated Jan. 1, 1913, and mature Jan. 1, 1966, but are callable at 110 and interest. The returns from this sale are to be used in connection with the new subway construction, and the agreement between the city and the company is such as to make the bonds in effect a quasi-municipal security. Before the city receives any return on its investment of $66,000,000 in the new lines, the contracts entitle the company to take out of net income approximately $14,769,000 per year for its own purposes, which sum is $5,409,000 in excess of the amount required for payment of the 5 per cent interest and 1 per cent sinking fund on its entire $156,000,000 issue of bonds. It is understood that over $22,000,000 of the $30,000,000 issue has already been sold.

Financial Status of the Consumers' Power Company of Minnesota.—In connection with the sale of $100,000 first mortgage 5 per cent bonds of the Consumers' Power Company of Minnesota, H. M. Byllesby & Company have issued a statement of the earnings of that utility company for the year ending Aug. 31. Gross earnings of $3,794,884 were realized, on which net earnings were obtained amounting to $1,931,651. These figures represented increases of 28 per cent and 32 per cent, respectively, over the figures for 1911. The Consumers' Power Company owns and operates various utility properties, serving about 40 communities in Minnesota, North Dakota, Illinois and Wisconsin, with a total population of approximately 750,000. During the fiscal year, ending Aug. 31, a total of 52,200 customers were served, energy was supplied to 55,524 hp in stationary motors and a connected load of 93,982 kw was recorded. Minneapolis and St. Paul are the largest cities in the territory supplied by this concern, and it owns undeveloped power sites in the vicinity of those cities, said to have a capacity of 60,000 hp, for future expansion of its generating system.

Annual Report of the Western Union Telegraph Company.—The annual report of the Western Union Telegraph Company for the year ending June 30, which was approved by the stockholders at their annual meeting on Oct. 8, is of particular interest at this time. As a matter of general convenience in the administration of the company's affairs, its fiscal year has been changed to cover the period from Jan. 1 to Dec. 31, so that this report is confined to the balance sheet and income account. A complete report under the new fiscal arrangement will be given at the annual meeting on the second Wednesday in April, 1914. The current assets of the company on June 30 were $9,414,483, and its current liabilities $4,364,132, while the surplus on the same date was $9,532,626. The total earnings for the year amounted to $46,385,993, of which sum $4,463,508 represented net profit. Dividend payments for the year aggregated $2,992,166, and bond interest payments amounted to $1,337,229, leaving a balance of $134,113 to be added to the surplus account. During the year ending June 30, the company's land line plant was extended by 26,020 miles of wire and 2174 miles of poles. The large office building under construction for the company in New York City will be completed about May 1, 1914. The company's policy is being continued of carrying to depreciation reserve all earnings over and above the present dividend requirements and charging reconstruction expenditures to that reserve. The existing board of directors and inspectors of election are to be continued in office until the stockholders' meeting in 1914, or until their successors are elected and qualified.

Business Notes

The Moloney Electric Company, of St. Louis, Mo., has opened an office at 1716 Fisher Building, Chicago, Ill. L. H. Keller will be in charge.

The Lindstrom Smith Company, of Chicago, Ill., has entered the electrical field and will do a jobbing business in all standard electrical supplies.

The New Process Specialty Company announces the removal of its office from 709 M. & M. Bank Building to 602-4-6 Enterprise Building, Milwaukee, Wis.

Hodenpyl, Hardy & Company, bankers, of 14 Wall Street, New York, announce the opening on Oct. 10 of a Chicago office at 621-22 First National Bank Building, under the management of H. M. Tingle, formerly with the First National Bank of Detroit, Mich.

Thomas A. Edison, Inc., announce the election of E. Hudson to the office of fourth vice-president of the company. Mr. Hudson will continue as heretofore in charge of the sales of the primary and battery department and will make his headquarters in Orange, N. J.

The U. S. Light & Heating Company announces the departure of its president, J. A. Smith, on Oct. 11, for a second trip to Europe this year. Mr. Smith's first trip was very successful in a business way, and the present trip is taken to attend to pressing company matters in England and on the Continent.

The Hurley Machine Company, of Chicago, has secured the services of Mr. George R. Purvis as special representative for its electrically operated washing machines and vacuum cleaners. Mr. Purvis was formerly manager of the appliance department of the Union Electric Light & Power Company, of St. Louis, Mo.

Fairbanks, Morse & Company, of Chicago, Ill., announce several organization changes. Their Southern department headquarters have been moved from Chicago to Atlanta, Ga., E. D. West remaining in charge. A New England office has been opened at 109 Lyman Street, Springfield, Mass., and R. F. Koops has been made manager.

The Cutler-Hammer Manufacturing Company, of Milwaukee, maker of electric controllers, has recently opened a new district office in Cincinnati, Ohio, located in the Fourth National Bank Building. The general increase in business has made it necessary to establish a permanent office in Cincinnati. Mr. Horace L. Dawson, formerly of the engineering department of the Cutler-Hammer Manufacturing Company, and recently one of the sales engineers connected with the Chicago office, will be in charge of the new office.

New Industrial Companies

The Penn Pressed Metal Company, of Merchantville, N. J., has been incorporated by F. A. Kuntz, J. D. Baker and F. S. Saurman, of Merchantville. The company is capitalized at $25,000 and proposes to manufacture pressed metal goods of all kinds for mechanical and electrical engineers, etc.

The Reeves-Cubberley Engine Company, of Trenton, N. J., has been incorporated with a capital stock of $50,000 for the purpose of carrying on business as electrical engineer, machinist, etc. The incorporators are: C. Reeves, of Trenton; A. A. Taylor, of Allentown, and W. P. Cubberley, of Robbinsville.

The American Electroscope Company, of Chicago, Ill., has been incorporated with a capital stock of $2,500 to manufacture and deal in electrical machinery and to conduct a general advertising and publishing business. The incorporators are George R. McIntrye, William H. Williamson and Stanley Kubbeener.

The J. & H. Electric Company, Inc., of Providence, R. I., has been incorporated with a capital stock of $10,000 to deal in and manufacture all machinery, appliances, devices and supplies used in electrical pursuits. The incorporators are Clarence E. Harmon, Warren M. Hodges and Lawrence E. Whitehead, all of Providence.

Trade Publications

Lighting Fixtures.—The George Cutter Company, South Bend, Ind., has recently issued a 16-page illustrated catalog telling about its Idealite fixtures for controlling light distribution.

Roller-Bearing Boiler-Tube Cleaner.—Bulletin X, recently issued by the Lagonda Manufacturing Company, Springfield, Ohio, describes a new type of water-driven boiler-tube cleaner.

Bolts.—The Van Expansion Bolt Mfg. Company, Fort Dearborn Building, Chicago, Ill., has published a little hand book which will familiarize the recipient with the Van specialties. Considerable information regarding the Van expansion unit is given.

Belt Dressing.—The Cling-Surface Company, Buffalo, N. Y., has issued a booklet with the title "Wherever you go the world over, a package of Cling-surface sits beside the belts." It describes and illustrates installations of Cling-surface in many foreign countries.

Electrical Supplies.—The Pacific States Electric Company, San Francisco, Cal., has published some additions to its loose-leaf catalog giving the latest price lists of a number of specialties which it handles. These take the place of price lists and discount sheets previously issued.

Conduits.—A sixteen-page booklet recently issued by the Sprague Electric Works of the General Electric Company, 527 West Thirty-fourth Street, New York, gives information respecting Sprague flexible-steel armored conductors and Greenfield flexible-steel conduit fittings and tools. The pamphlet also contains dimensions and prices of the devices and materials listed.

Pyrometers.—The Brown Instrument Company, Philadelphia, recently sent a letter to 4000 users of Brown electric pyrometers asking if the results from their use were satisfactory. A copy of this letter, with copies of 100 replies, has been printed in pamphlet form. The replies are arranged under headings of the various industries in which the pyrometers are being used.

Lighting the Home.—The National X-ray Reflector Company, Chicago, has published in pamphlet form the article by Evelyn Marie Stuart on "The Lighting of the Home," which recently appeared in the *Fine Arts Journal*, The account is very interesting, and the excellent illustrations show the pleasing effects obtainable by indirect illumination with specially designed bowls.

Porcelain Insulations.—J. H. Parker & Son, 17 Highland Street, Chelsea, Mass., in a forty-two-page publication recently issued illustrate their line of porcelain insulations. One section is devoted to knobs, cleats, bushings, switch bases, insulators and other devices made by the dry process, and another section refers to tubes, insulators and special appliances manufactured by the wet process.

Electricity on the Farm.—"Electricity on the Farm," the title of a bulletin recently issued by the General Electric Company, represents an exhaustive treatise on this subject and contains a wealth of practical statistical information of a nature not hitherto available to the farmer, the central station manager, or the sales agent. For these reasons the publication should prove of unusual interest to all engaged in the extension of electrical service on the farm.

Electric Drills.—The Standard Electric Tool Company, Cincinnati, Ohio, in its Bulletin D-9 shows illustrations of and describes the "Standard" high-power direct-current portable electric drills. These drills are built on the unit plan, consisting of five simple parts. They can easily be dismembered without disturbing any electrical connections. In Bulletin D-A 10 high-power two-phase and three-phase alternating-current portable electric drills are described.

Turbines.—Bulletin No. A4137, recently issued by the General Electric Company, illustrates and describes Curtis steam turbines of 100 to 2500 kw. capacity, for driving 60-cycle generators at 3600 r.p.m. These generating sets are of the horizontal-shaft rigid-frame type and either two or four impulse wheels are used, depending upon the capacity of the generator. The bulletin is fully illustrated, showing details of turbine construction, path of steam flow and a number of typical installations.

Personal Mention

Mr. H. J. Willis, for six years superintendent of the La Crosse (Kan.) municipal electric light station, has been appointed superintendent of the new municipal plant at Scott City, Kan.

Mr. A. L. Scott, assistant sales agent of the Metropolitan Electric Company, of Reading, Pa., has been appointed sales agent of the Edison Electric Illuminating Company of Lebanon, Pa.

Mr. H. J. Pettingell, Jr., for four years commercial agent of the Paducah (Ky.) Light & Power Company, has been appointed manager of the commercial department of the Stone & Webster interests at Woonsocket, R. I.

Mr. M. J. Warner, of the firm of Young & Warner, will assume the post as general manager of the Rockville-Willimantic Lighting Company, of Willimantic, Conn., as successor to Mr. W. M. Lewis who has resigned.

Mr. David H. McCormick, vice-president of the Rockville (Conn.) Gas & Electric Company, has been appointed agent of the company, assuming part of the duties of Mr. William M. Lewis who recently resigned to accept the post of general manager of the Grand Rapids-Muskegon Power Company.

Mr. T. C. Martin, secretary of the National Electric Light Association, is taking a vacation trip abroad of about a month, sailing on the *Lusitania.* He will visit two or three capitals to study the central station industry and dispose personally of the many inquiries that have arisen in regard to the new class of foreign company membership in the Association.

Mr. Herbert C. Tinker, of Jackson, Mich., who during the summer months has been temporary manager of the Grand Rapids-Muskegon Power Company at Muskegon has returned to Jackson and resumed his duties with the Au Sable Electric Company. Mr. Tinker has been succeeded at Muskegon by Mr. W. M. Lewis until recently manager of the Rockville-Willimantic Lighting Company.

Mr. M. A. Carter, who during the summer was in charge of the Salisbury Beach division of the Amesbury (Mass.) Electric Light Company has been placed in charge of the new business department and reconstruction work of the recently formed electric light company in Provincetown to be known as the Provincetown Light & Power Associates. Mr. Carter was for years manager of the Weymouth Light & Power Company and his associates in Amesbury presented him with a fine traveling bag as he left for his new field of endeavor.

Mr. William M. Lewis has resigned as manager of the Rockville-Willimantic Lighting Company, of Willimantic, Conn., to accept the position as manager of the Grand Rapids-Muskegon Power Company at Muskegon, Mich., as successor to Mr. H. C. Tinker. Mr. Lewis joined the Rockville-Willimantic Lighting Company which owns and operates the Rockville Gas & Electric Company, the Stafford Springs Electric Light & Gas Company and the Willimantic Gas & Electric Company several years ago from Summerville, N. J., and during his incumbency has rebuilt the Rockville plant as well as the plants at Stafford and Willimantic. A farewell dinner was tendered to him on Oct. 4 at which Mr. Lewis was presented with a gold watch from the employees of the company.

Mr. E. B. Burritt, of the Washington Railway & Electric Company, who has taken up his new duties as secretary-treasurer of the American Electric Railway Association in New York, was presented with a traveling bag by the officials of the Washington Railway & Electric Company on severing his connections with the utility. During the past seven years Mr. Burritt has occupied important positions with the Washington company serving as private secretary to Gen. George H. Harries during the latter's connection with the company and recently as an executive officer attached to President King's office where important details of street railway management were placed in his hands. Mr. Burritt succeeds Mr. H. C. Donecker, an account of whose resignation was published on June 14, 1913.

Mr. R. S. Hale, the originator of the idea of "get together" meetings of the sales managers of the big Edison companies, has just rounded out twenty years of service with the Edison Electric Illuminating Company, of Boston. At the recent meeting of the sales managers at Association Island, N. Y., Mr. Hale, after four years of service, resigned as chairman, and as a memento of his work for that organization he was presented with a handsome gold and platinum cigarette case during the Edison convention at Cooperstown, N. Y. Mr. Hale, who is a graduate of Roxbury Latin School, and holds the degree of A. M. from Harvard and of M. E. from Cornell, entered the service of the Boston Edison Company in October, 1893, and was engaged in making engine and boiler tests. In 1895 he was engaged by the Steam Users' Association to report on the cost of steam in the United States and Europe. He acted as consulting engineer for the Mutual Boiler Insurance Company, and was a member of the firm of Hale & Cotton, which was interested in general electrical work. At practically every electric light convention Mr. Hale was present as consulting engineer for the Boston Edison Company, and in 1904 he was made assistant to the general superintendent. He later became superintendent of the sales department and was recently made superintendent of the research department, in which capacity he now serves. While at Harvard and at Cornell, Mr. Hale was interested in athletics. He was captain of the track team at Cornell, and holds the Harvard record for the mile and three-mile walks. Last year he was elected a trustee of the Roxbury Latin School, founded in 1645, the oldest endowed school in America. Mr. Hale is a member of the American Society of Mechanical Engineers, American Institute of Electrical Engineers, Boston Society of Civil Engineers, Illuminating Engineering Society, National Electric Light Association, Electric Motor Car Club of Boston, Tennis and Racquet Club, Exchange Club, Engineers' Club, Brookline County Club, Dedham County Club, Hoosick Whissick Club, Harvard Club of New York, University Club of New York and the Century Association of New York.

R. S. HALE

Obituary

Dr. Rudolph Diesel, who disappeared from an English Channel steamer Sept. 29, as noted in our issue of Oct. 4, is believed to have fallen overboard and been drowned. A body washed ashore Oct. 13 at the mouth of the River Scheldt near Flushing, Holland, has been identified as that of Dr. Diesel by his son and by persons who knew the dead inventor. At the time of his disappearance Dr. Diesel was on his way from Antwerp to Harwich to attend a meeting of the Diesel company at London. Rudolph Diesel was born in Paris in 1858, and received his higher education in Augsburg, Germany, and at the Polyclinic College, Munich. He was the inventor of the internal-combustion type of engine identified with his name, although in recent years he had taken a less active part in the manufacture of these units. Dr. Diesel last visited America in April, 1912, and presented papers at meetings in St. Louis, Chicago and New York.

RUDOLPH DIESEL

Construction

New England

BECKET, MASS.—The Berkshire & Becket Silk Companies, Ltd., are planning to install an electric generator in their plant to generate electricity for lighting the mill.

HOLYOKE, MASS.—Bids will be received by P. M. Judd, chairman of Board of Fire Commissioners, Holyoke, Mass., until Nov. 18 for furnishing underground fire alarm cable, combination fire alarm and cable posts and cable boxes; also for fire alarm telegraph system. Further information may be obtained at the office of Thomas F. Monaghan, superintendent of fire alarm.

LAWRENCE, MASS.—The Board of Selectmen has awarded the Lawrence Gas Co. a contract for lighting the streets of the city for a period of three years. The contract provides for replacing the present lamps with 368 tungsten incandescent lamps of 40 cp, to cost $16 each per year.

SPRINGFIELD, MASS.—Plans calling for the installation of a duplicate steam plant for the United States Armory in Springfield, have been submitted by Col. William S. Pierce, commandant of the armory, to the Ordnance Department of the United States Army. The plans call for an expenditure of $50,000 and provide for the installation of two steam turbo-generator sets with a rating of 500 hp each. It is proposed to replace the present shaft transmission system with electric motors.

SPRINGFIELD, MASS.—The stockholders of the Union El. Lt. Co., of Springfield, have voted to increase the capital stock of the company from $1,500,000 to $1,750,000. While the increase in capital stock is only $250,000 the amount will be $500,000 as the new stock is to be sold at $200 per share in accordance with the decision of the Gas and Electric Light Commissioners. The proceeds of the stock will be used for extensions to plant, the purchase of a 4500-kw turbine, four new boilers and to meet the cost of underground work.

PAWTUCKET, R. I.—Plans are being prepared for the construction of a new three-story building for the What Cheer Chemical Co., on Grotto Avenue. A power house and boiler room will be erected.

MIDDLETOWN, CONN.—The proposed change in the street-lighting system on Main Street has been approved by the Business Men's Association, which will submit the proposition to the Council. The plans provide for the installation of 44 ornamental standards carrying cluster lamps to replace the present arc lamps from St. John's Square to the South Church.

NORWICH, CONN.—The Board of Lighting Commissioners expects to erect within the next two months one gas container (500,000 cu. ft. capacity), contract for which has been awarded to the R. D. Wood Co., of Philadelphia, Pa. S. J. Kehoe is superintendent.

Middle Atlantic

BINGHAMTON, N. Y.—The Afton-Windsor Lt., Ht. & Pwr. Co., of Binghamton, has applied to the Public Service Commission for permission to erect a transmission line for the purpose of furnishing energy for lamps, heat and motors in the village of Afton, and the village and town of Windsor, and the town of Colesville; also for permission to increase the capital stock of the company from $5,000 to $50,000 and to issue $60,000 in bonds.

BROOKLYN, N. Y.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until Nov. 8 for changes in the lighting system, United States post office building, Brooklyn, N. Y., in accordance with drawings and specifications, copies of which may be obtained at the above office or at the office of the supervising engineer. O. Wenderoth is supervising architect.

JAMESTOWN, N. Y.—Preparations are being made by the Jamestown St. Ry. Co. for the construction of an addition (75 ft. by 62 ft.) to its power station to provide space for 18 transformers. In December the company expects to install a 5000-kw Westinghouse-Parsons turbo generator set in the present power station.

NEW YORK, N. Y.—The contract for installing lighting fixtures in the new post office in New York City has been awarded to Wahle-Phillips Co., of New York, at $10,622.

NEW YORK, N. Y.—Plans have been filed by the New York Edison Co. for an electric-light and power station in the Bronx. The building will be erected at 327 to 341 Rider Avenue, and will cost about $20,000. William Weissenberger, Jr., is architect.

NEW YORK, N. Y.—Bids will be received by the Department of Public Charities, foot of East Twenty-sixth Street, New York, N. Y., until Oct. 24 for furnishing labor and material required for the construction and installation of additional mechanical equipment for the power house and laundry building at Randalls Island, city of New York. Blank forms and further information may be obtained at the office of Frank J. Helme, architect, 190 Montague Street, Brooklyn, where plans and specifications may be seen.

NEW YORK, N. Y.—Bids will be received by C. B. J. Snyder, superintendent of school buildings, Department of Education, Park Avenue and Fifty-ninth Street, New York, N. Y., until Oct. 20 for installing electric equipment in new Public School 22, on the corner of Washington and Columbus Avenues, Graniteville, borough of Richmond. Blank forms, plans and specifications may be seen or obtained at the office of the superintendent, Park Avenue and Fifty-ninth Street, borough of Manhattan; and also at branch offices, 69 Broadway, Flushing, borough of Queens; Borough Hall, New Brighton, borough of New Richmond.

NEW YORK, N. Y.—Bids will be received by the Panama-Pacific Commission of the State of New York, at the office of the commission, 140 West Forty-second Street, New York, until Nov. 8, for construction of the New York State Building on the grounds of the Panama-Pacific Exposition, San Francisco, Cal., as follows: (1) For erecting building; (2) installing plumbing, water supply and gas fitting in above building; (3) installing steam heating system; (4) installing the electric work. Forms of proposals, together with copies of contracts and specifications may be had at the office of the commission, and drawings may be obtained from Charles B. Meyers, architect, 1 Union Square West, New York. Norman E. Mack is chairman of commission.

OSWEGO, N. Y.—The Minetto-Meriden Co., it is reported, will apply for a franchise to erect a transmission line from its plant at the Minetto dam into Oswego to furnish energy for manufacturing purposes.

ALTOONA, PA.—A special meeting of the stockholders of the Penn Central Lt. & Pwr. Co. will be held Oct. 20 to vote on the proposition to increase the capital stock of the company from $5,000,000 to $7,500,000.

EASTON, PA.—The directors of the Eastern Pennsylvania Pwr. Co., of Easton, have approved a merger with the Pennsylvania Utilities Co., of Nazaeth. The new company will be known as the Pennsylvania Utilities Co. and will operate the light, heat and power companies in Easton, Nazareth, Bath, Penargyl, Bangor, Stroudsburg and Columbia. Carl M. Pihl, of Easton, president of the Eastern Pennsylvania Co., will be president of the new company, A. D. Lord, of Summit, N. J., vice-president; F. B. Shannon, treasurer, and A. B. Cheadle, secretary, both of New York, N. Y.

PHILADELPHIA, PA.—The contract for the installation of an electric-lighting and power system at the Dock Street pier, has been awarded to the Thompson El. Co., 1606 Samson Street, Philadelphia, for $6,488.

PORTVUE, PA.—The Borough Council has granted the West Penn El. Co., Pittsburgh, a franchise to install an electric-light system in Portvue. Post office address Portvue, R.F.D. McKeesport.

SHARON, PA.—Papers have been filed with the State Department announcing the absorption by the Mercer County Lt., Ht. & Pwr. Co. of the Stoneboro Pwr. Co., Lake Pwr. Co., Fairview Pwr. Co., Sandy Lake Pwr. Co. and Sandy Lake Suburban Pwr. Co., all recently chartered in Mercer County.

MORRISTOWN, N. J.—The Morris & Somerset El. Co. has begun work on the erection of a new three-phase, high-tension trunk line between Morristown and Whippany. The company proposes to furnish electrical service in Hanover Township.

NEWARK, DEL.—The Water and Light Commission expects to purchase within the next six months some lamps for use in connection with the municipal electric-light plant.

LONACONING, MD.—The Home El. Lt. Co., of Lonaconing, has applied to the Public Service Commission for permission to issue $20,000 in bonds, the proceeds to be used to purchase the plant and holdings of the Lonaconing El. Lt. & Pwr. Co.

MOUNT AIRY, MD.—The town of Mount Airy is considering the question of establishing a municipal electric-light plant.

RICHMOND, VA.—Investigations are being made by a committee of the Council into the advisability of purchasing the Pocahontas Cotton Mill property in Battersea, with a view of drawing the city's water supply from that source. In connection with this matter it is said that investigations are being made with a view of establishing a municipal electric-light plant at that point.

WASHINGTON, D. C.—Tenders will be received until Nov. 15 by the Agent General for Victoria, Melbourne Place, Strand, London, W. C. England, for overhead electrical equipment of permanent way and overhead transmission mains in connection with equipping the Melbourne Suburban Railways for electrical operation now being carried out.

WASHINGTON, D. C.—The Commissioners of the District of Columbia have submitted a recommendation to Congress asking an appropriation of $3,000,000 to provide for the purchase of the Potomac River water falls and for the beginning of the work. It is proposed to develop the water power to generate electricity for lamps and motors in Washington. The total cost of the work is estimated at $15,000,000.

North Central

CHEBOYGAN, MICH.—The Cheboygan El. Lt. & Pwr. Co. has applied to the State Railroad Commission for permission to issue $250,000 in bonds.

COLON, MICH.—Within the next nine months the United El. Co., of Colon, expects to erect 20 miles of 13,200-volt transmission line, and to purchase within the next eight months one 30-kva, 60-cycle, three-phase, 2300-volt revolving field (belted) generator, 1200 r.p.m. Edgar Seaver is manager.

DUNDEE, MICH.—The Dundee Hydraulic Pwr. Co. is making extensive changes at its plants and rebuilding its electric lines for lamps and power. All machinery and equipment have been purchased. H. G. Gray is manager.

DURAND, MICH.—The Water and Light Commission expects to purchase within the next eight months a 150-hp engine for the municipal electric-light plant. D. M. Trumbull is secretary.

FREEMONT, MICH.—A proposition has been submitted to the Village Council by Walter Snow, who owns a water power site on the White River, to serve this village with electrical energy for lamps and motors. Mr. Snow states that 1500 hp can be developed and asks for a contract for 1000 hp before beginning the development.

KALAMAZOO, MICH.—Steps have been taken by the property holders on South Street to secure an extension of the ornamental street-lighting system.

MILLINGTON, MICH.—Oliver B. Whipple, owner of the local electric-light plant, expects to erect within the next two months one 6000-gal. to 8000-gal. oil storage tank. A new oil-engine-driven plant is now being installed, consisting of one 25-hp and one 35-hp Alamo oil engine. As soon as improvements are completed energy will be generated at the plant, instead of being purchased as at present.

ATHENS, OHIO.—Bids will be received by the Board of Trustees of the Ohio University at Athens until Nov. 5 for furnishing materials, construction and installation of a plant for the Ohio University to be used for lighting, power and experimental purposes, according to plans and specifications prepared by A. A. Atkinson and George McLoughlin, engineers, of Athens, which are on file at the office of the secretary of the Board of Trustees, Athens, at the office of the engineers, and at the office of the auditor of state and H. H. Hannig, treasurer. I. M. Foster is secretary of board of trustees.

CANTON, OHIO.—The Barber Mining & Fertilizer Co., recently organized, it is reported, will ask for a franchise to furnish electrical energy in Canton. The company proposes to erect a plant at Howenstein, to cost about $150,000. Homer B. Briggle is general manager.

CINCINNATI, OHIO.—The Cincinnati, Lebanon & Northern R.R. Co. is contemplating equipping its railroad for electrical operation. The present plans, it is said, provide for the erection of a power plant in Cincinnati, at Fourth and Canal Streets, and extending the service to Monroe, Bethany, Mauds, West Chester and other villages on the way to Middletown.

CLEVELAND, OHIO.—The Cleveland El. Illg. Co. will erect a switch house addition to its new plant at 782 East Seventieth Street. The building will be 35 ft. by 168 ft., three stories high, and will cost about $45,000.

CLEVELAND, OHIO.—Bids will be received at the office of the secretary to the director of public service, 204 City Hall, Cleveland, until Oct. 25, for general building construction for the municipal electric-light plant of Cleveland. Plans and specifications may be obtained at the office of the engineer of construction, 419 City Hall. W. J. Springborn is director of public service and W. H. Kirby, secretary.

DEFIANCE, OHIO.—Authority has been granted to the Defiance Gas & El. Co. by the State Utilities Commission to issue $114,000 in bonds, the proceeds to be used for improvements and extensions to its system.

LIMA, OHIO.—An Auxiliary power house, it is reported, will be erected on North Main Street by the Ohio El. Ry. Co. The plans provide for a building 40 ft. by 60 ft.

LIMA, OHIO.—The City Council has adopted a resolution authorizing the submission of a $40,000 bond issue to the voters on Nov. 4 for the purpose of installing an ornamental street-lighting system and to construct a municipal electric-light plant.

LIMA, OHIO.—The Schoepf syndicate, it is reported, has announced that improvements involving an expenditure of $78,000 will be made to its system in this section, including the erection of a sub-power house in Lima. Energy for operating the railways of the Toledo, Fort Wayne & Defiance in this vicinity has been purchased from the Western Ohio Ry. Co. The new plant will have sufficient output to operate all the lines, even to Springfield on the south.

NATIONAL MILITARY HOME, OHIO.—Bids will be received at the office of the treasurer, central branch, National Home, Disabled Volunteer Home, National Military Home, Ohio, until Oct. 23 for furnishing motor-generator set, motors, transmission line, power pumps and piping for improvement of water supply at lake pumping station, in accordance with instructions and specifications, copies of which with blank proposals, etc., may be obtained upon application to W. H. Ortt, treasurer.

PORT CLINTON, OHIO.—The City Council has decided to submit the proposition to issue $30,000 in bonds to establish a municipal electric-light plant to the voters at the election to be held Nov. 4.

ST. BERNARD, OHIO.—The City Council has adopted an ordinance authorizing an issue of $30,000 in bonds for improvements to the municipal electric-light plant. It is proposed to change the system from 133 cycles to 60 cycles.

DIXON, KY.—The installation of an electric plant in connection with their flour mill is being considered by Melton Brothers, of Dixon.

HICKMAN, KY.—The Hickman El., Ice & Wtr. Co. has recently enlarged its deep wells, drilled an additional well and increased the capacity of its ice plant, and it is now installing water meters and making various extensions to its water mains and electric lines. Window-lighting service has been inaugurated and an ornamental street-lighting system is being developed. A. D. Brinkerhoff, of St. Louis, is secretary and treasurer of the National Lt. & Pwr. Co., of St. Louis, which controls the Hickman company.

HODGENVILLE, KY.—The Hodgenville Lt. Co. expects to purchase within the next four or five months boiler, engine and dynamo and to establish a 24-hour service; also to furnish energy for motors. D. E. Paterson is owner.

JENKINS, KY.—The Consol. Coal Co., which has large electric power plants at its mines in Jenkins and also at its Van Lear operations, near Paintsville, is now erecting a high-tension transmission line from Jenkins via Beaver Creek, to Van Lear, a distance of 65 miles, to connect the two plants. When this line is finished the local power stations in Pikeville and Prestonburg will be closed down and energy will be obtained from the transmission line. Another transmission line will be erected along the Elkhorn Creek from Jenkins to Elkhorn City for the purpose of furnishing electrical energy in Elkhorn, Marrowbone Creek, for mining operations and for lamps in the town of Shilbiana.

INDIANAPOLIS, IND.—Arrangements are being made by the Electric Steel Co. of Indiana (recently incorporated), for the erection of a new steel plant in Indianapolis. The company is capitalized at $100,000 and it will use an electric furnace patented by H. H. Buckman, Jr., of Indianapolis. Hugh McK. Landon, J. D. Forrest, George A. Weidely, Chester P. Wilson and H. H. Buckman, Jr., are interested in the company.

BLUE ISLAND, ILL.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until Nov. 10 for the construction complete, including mechanical equipment, interior lighting fixtures and approaches of the United States post office at Blue Island, Ill. Drawings and specifications may be obtained at the above office or from the custodian of site at Blue Island. O. Wenderoth is supervising architect.

CHICAGO, ILL.—Bids will be received by the city of Chicago until Oct. 22, at room 406, City Hall, for furnishing nine direct-current electric motors at the water works shops, at 2304 South Ashland Avenue, Chicago. Motors to vary in size from 2 hp to 15 hp, according to plans and specifications on file in the office of the Department of Public Works, Room 406, City Hall. L. E. McGann is commissioner of public works.

DIXON, ILL.—Within the next three months the Illinois Northern Utilities Co., of Dixon, expects to erect four 33,000-volt outdoor substations and to purchase electrolytic lightning arresters, high-tension disconnecting switches, fuses, etc., for above stations and central stations feeding same; also lightning arresters, insulators, transformers and poles, necessary for extensions and maintenance in 39 towns which it supplies with energy; series incandescent lamps and regulators for upward of 600 street lamps; also electrical appliances and supplies, including heating and cooking apparatus, vacuum cleaners, washing machine, etc., as requirements demand. The company has recently installed 40 ornamental street lamps in Dixon, using Magnetite luminous arc-lamps. L. E. Marshall is manager.

EDWARDSVILLE, ILL.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until Nov. 18 for construction, including mechanical equipment, interior lighting fixtures and approaches, of the United States post office at Edwardsville, Ill. Drawings and specifications may be obtained at the above office or from the custodian at Edwardsville. O. Wenderoth is supervising architect.

PANA, ILL.—The City Council has authorized the light committee to investigate the cost of installing and operating an electric-light plant.

CORNELL, WIS.—We are informed that no definite action has yet been taken toward the installation of a municipal electric-light plant. L. G. Arnold, of Chippewa Falls, Wis., is consulting engineer.

DELAVAN, WIS.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until Nov. 14 for the construction, including mechanical equipment, interior lighting fixtures and approaches, of the United States post office at Delavan, Wis. Drawings and specifications may be obtained from the above office or from the custodian of site at Delavan. O. Wenderoth is supervising architect.

GREEN BAY, WIS.—The Wisconsin Public Ser. Co., of Green Bay, has purchased the electric utility property of the Minahan Building and is now operating the same, having taken possession on Sept. 12. C. R. Phenicie is general superintendent.

MILWAUKEE, WIS.—The joint committee on finance and street lights has adopted a resolution to ask for bids from the electric service companies for lighting the city with electricity for the next five or ten years. This action was taken by the committee in conformity with the recommendation of the Wisconsin Railroad Commission, whose experts reported that the city could save at least $46,000 per year by entering into a contract with an existing concern rather than establishing a municipal plant for street lighting.

OSSEO, WIS.—Application has been made to the Village Board by J. N. Lee & Sons for a franchise to construct and operate an electric-light system in Osseo. The plant will be operated in connection with the mill. A 30 hp oil engine will be installed to be used when the water-power gives out. Storage batteries will be used to supply power for day

service. The proposed street-lighting system provides for the installation of 24 incandescent street lamps, at a cost of $600 per year.

BLUE EARTH, MINN.—An ornamental street-lighting system will be installed in the business portion of the city. Five-lamp clusters will be used. The citizens have subscribed $2,000 toward the project.

FERTILE, MINN.—The City Council has decided to call a special election to vote on the proposition to install a municipal electric-light plant in Fertile.

INTERNATIONAL FALLS, MINN.—The City Council has awarded the contract for conduits, lamp standards and lamps for the ornamental street-lighting system in the business section to F. O. Peterson, of Duluth, for $4,962. Arc lamps will be used.

EARLVILLE, IA.—The question of enlarging the municipal electric-light plant is under consideration.

McGREGOR, IA.—An election will be held Oct. 20 to submit the proposition to grant the McGregor El. Lt. & Pwr. Co. a franchise to erect and maintain transmission lines to Monona for the distribution of electricity in Monona and villages and farmers along the line.

MALVERN, IA.—At an election held recently the proposition to grant the Red Oak El. Co., of Red Oak, a franchise in Malvern was defeated.

OELWEIN, IA.—The City Council has granted a franchise to T. J. Mulgrew, A. F. Heeb and T. J. Fitzpatrick, all of Dubuque, to install and operate an electric-light plant in Oelwein. A special election will be held to submit question of granting the franchise to the voters.

PERRY, IA.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until Nov. 20 for the construction, including mechanical equipment, interior lighting fixtures and approaches of the United States post office at Perry, Ia. Drawings and specifications may be obtained at the above office or from the custodian of the site at Perry. O. Wenderoth is supervising architect.

ALBANY, MO.—The contract for construction of a new municipal power plant has been awarded to the Commercial Construction Co., of Kansas City, Mo., at $12,000. W. E. Noonan is superintendent.

MANDAN, N. D.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until Nov. 18 for the construction, including mechanical equipment, interior lighting fixtures and approaches, of the United States post office at Mandan, N. D. Drawings and specifications may be obtained at the above office or from the custodian of site at Mandan. O. Wenderoth is supervising architect.

WAHPETON, N. D.—Bids will be received at the office of the auditor of Richland County, Wahpeton, N. D., until Oct. 28 for furnishing and installing furniture and fixtures, electric-light fixtures and decorating the new Richland County court house. Separate bids to be submitted as follows: (a) For furniture and fixtures and window shades; (b) for steel counters in offices and vault tables (not including vault fixtures); (c) electric-light fixtures; (d) for decorating. Plans and specifications may be seen at the office of Buechner & Orth, architects, 500 Shubert Building, St. Paul, Minn., and at the office of F. A. Burton, county auditor, Wahpeton; copies may also be secured upon application to the architects.

PLANKINTON, S. D.—The local electric-light plant is reported to have been purchased by J. B. Jones, of Presho. The new owner, it is understood, will improve and extend the system.

DORCHESTER, NEB.—Plans are being prepared by C. O. Martz, 1208 S Street, Lincoln, Neb., engineer, for an electric-light plant (distributing system only) and transmission line and water works system in Dorchester, bonds for which have already been voted. Energy for operating electric system will be obtained from private plant. Bids, it is said, will be called for the latter part of December. The cost of the electric system is estimated at $15,000 and the water works at $5,000. W. W. Wall is city clerk.

GREELEY, NEB.—A special election will be called to submit the proposition to grant a franchise to F. J. Buckley to install an electric-light and power plant in Greeley to the voters.

CHERRYVALE, KAN.—Preparations are being made by the Kansas Gas & El. Co., of Wichita, for the erection of a high-tension transmission line between Cherryvale and Independence.

GARNETT, KAN.—At an election to be held Oct. 14 the proposition to issue $15,000 in bonds for a municipal electric-light plant will be submitted to the voters. The purchase of the local electric plant, owned by the Garnett El. Lt. Co., is under consideration. J. Q. McAfee is president of the company.

HUTCHINSON, KAN.—The United Wtr., Gas & El. Co., of Hutchinson, is installing a new ornamental street-lighting system, and also contemplates some extensions to the street series arc-lamp lighting system; also to the water system. The company does not contemplate the immediate purchase of any considerable amount of additional equipment. J. F. Springfield is general manager.

Southern States

CAMDEN, S. C.—Bonds to the amount of $125,000 have been sold, of which the proceeds of $35,000 will be used for the installation of a municipal electric-light plant and $90,000 for construction of water works and filtration system. T. C. White is consulting engineer for the city commission.

WALHALLA, S. C.—Preparations are being made by the Linler Pwr. Co., of Walhalla (recently incorporated with a capital stock of $100,000), for the construction of a hydroelectric power plant on Little River, 8 miles north of Walhalla. The equipment of the proposed plant will consist of two pairs of turbines with a rating of 325 hp each, two water wheel governors, two 300-kw (each), 60-cycle, three-phase, 22,000-volt generators, switchboard, six 150-kva (each), 2200-22,000-volt transformers, outdoor type; two substations will be erected, one at Walhalla and the other at Westminster; 400 poles and 24 miles of No. 2 copper wire will be used for overhead distribution system; 40 General Electric 6.6 amp. arc lamps will be used. Contracts for construction of plant will be let Oct. 18. John Q. Linder is interested in the company.

HIGH SPRINGS, FLA.—The contract for the construction of the proposed municipal electric-light plant has been awarded to the J. B. McCrary Co., of Atlanta, Ga. Bonds to the amount of $35,000 were recently voted for the installation of an electric-light plant and water works system.

JUPITER, FLA.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until Nov. 1 for the construction of power house at the United States radio station, at Jupiter, Fla. Specifications may be obtained upon application to the above bureau. The amount available for the work is $2,400. H. R. Stanford is chief of bureau.

BAY MINETTE, ALA.—The installation of an electric-light plant in Bay Minette is under consideration. Frank S. Stone, of Bay Minnette, is reported to be interested in the project.

GEORGIANA, ALA.—The city of Georgiana contemplates the installation of a municipal electric-light plant and water works system. For further information address W. H. Holloway, secretary of Commercial Association.

HUNTSVILLE, ALA.—The contract for the installation of a conduit and wiring system in the United States post office in Huntsville, Ala., has been awarded to the Herman Andrae El. Co., 139 Sycamore Street, Milwaukee, Wis., at $5,015.

POCAHONTAS, ARK.—Arrangements are being made by the Pocahontas Lt., Pwr. & Ice Co. to improve the electrical service in Pocahontas. As soon as the transmission line between here and Walnut Ridge is completed both plants will be combined and a 24-hour service established. B. Morrison is manager.

PLAQUEMINE, LA.—The Dunlap El. Co. expects to erect an ice plant within the next six months. F. E. Hubbard is secretary and treasurer.

CHICKASHA, OKLA.—The Chickasha Lt., Ht. & Pwr. Co. has awarded the contract for construction of addition to its electric-light plant to Lisle Deming Construction Co., for $10,000.

FORT WORTH, TEX.—The Fort Worth Pwr. Co. has awarded contract for construction of power house (brick and concrete) to the Cleveland Construction Co., of Cleveland, Ohio, for $6,000.

GALVESTON, TEX.—At a special meeting held recently the stockholders of the Galveston-Houston El. Co. authorized an increase of $2,000,000 in capital stock, the proceeds to be used for extensions and improvements.

PITTSBURG, TEX.—Steps have been taken to erect a new electric-light and ice plant in Pittsburg. About $15,000 has been subscribed by the local business men.

SAN DIEGO, TEX.—The local electric-light plant which was destroyed by fire will be rebuilt. S. G. Smith is interested in the enterprise.

Pacific States

RAYMOND, WASH.—The Willapa El. Co., of Raymond, recently organized, will purchase the properties and franchises of the Willapa Harbor Ry. Co., of Raymond, and the Twin City El. Co. The power stations are located in Raymond and South Bend. New equipment will be installed including a 1000-kw, three-phase, 2300-volt Curtis turbine and switchboard apparatus. J. S. Thornton is interested in the company.

SPOKANE, WASH.—Plans, it is reported, have been completed for the installation of a cluster lighting system on Riverside Drive, to cost about $25,000.

KENO, ORE.—State Engineer John H. Lewis announces that preliminary surveys have been made for a large water project on the Klamath River, below Keno. The surveys were made under the state law authorizing the co-operation of state and federal governments. The project provides for the construction of a canal 10½ miles long, terminating about 2 miles above the California-Oregon boundary line, and the development of about 100,000 hp.

IMPERIAL, CAL.—The proposition to issue $26,000 in bonds for the installation of a municipal electric-light plant in Imperial will soon be submitted to the voters.

LOS ANGELES, CAL.—The City Council has authorized the Board of Public Works to advertise for bids for lighting the city for a term of two years, the city to reserve the right to annul the contract at the end of one year upon paying the lighting company for the 550 lamps to be installed during the year 1914.

OROVILLE, CAL.—Preparations, it is reported, are being made by the Great Western Pwr. Co. to extend its electrical service to Grass Valley and Nevada City. The proposed transmission line would furnish electrical energy in Forbestown and a large number of mines in that vicinity.

SAN FRANCISCO, CAL.—Application has been made to the Board of Supervisors by the Universal Gas & El. Co. (controlled by Spreckels interests), for permission to extend its electric and gas service throughout the city.

SAN FRANCISCO, CAL.—Application has been made to the State Railroad Commission by the United Lt. & Pwr. Co., of San Francisco, for permission to issue a note to the amount of $6,000, to provide funds for an extension in Oakland.

SONOMA, CAL.—The Railroad Commission of California has granted the Sonoma Valley Wtr., Pwr. & Lt. Co., of Sonoma, permission to issue $30,000 in bonds, of which the proceeds of $9,000 will be used for refunding existing indebtedness, and the remainder for extensions and improvements to its property.

BOISE, IDAHO.—The Idaho Pwr. & Lt. Co., of Boise, recently organized, has taken over the holdings of the Beaver River Pwr. Co. in Boise and southern Idaho, together with all franchises of its power and transmission lines, including the 7500-hp plant on the Malad River and the distribution systems in Boise and other Idaho towns. The officers of the company are: L. L. Nunn, president; W. L. Biersach, treasurer; E. P. Bason, general manager, and Jesse B. Hawley, general counsel.

NEW MEADOWS, IDAHO.—The Adams County Lt. & Pwr. Co., of New Meadows, will construct a hydroelectric power plant on the Little Salmon River and will also erect a 22,000-volt transmission line (80 miles long) to furnish energy in Meadows, New Meadows, Tamarack and Council in Adams County, McCall in Boise County, and Cambridge and Midvale in Washington County. B. Gustad is president and general manager.

BAKER, MONT.—If granted a satisfactory franchise, R. R. Pearce, it is reported, will install an electric-light plant in Baker.

SIDNEY, MONT.—The construction of an electric-light plant in Sidney is under consideration. Dr. Beagle, W. L. Bell and others are interested.

STERLING, COL.—The Sterling Consol. El. Co., of Sterling, expects to erect next spring about 10 miles of cross-country transmission line, developing a pumping service for irrigation purposes. H. L. Titus is manager.

RENO, NEV.—Secretary Houston has granted the Truckee River General Electric Co., of Reno, Nev., permission to develop water power in the Eldorado National Forest, California, to supply energy in Sacramento, Stockton and other surrounding towns. The initial installation of the proposed plant will provide for 16,000 hp, which will be doubled as the demand increases. Water will be secured from the Rubicon River. The plans provide for the construction of a tunnel 1½ miles long.

Canada

MEDICINE HAT, ALTA.—Plans are being considered by the City Council to increase the output of the municipal electric-light plant by 2500 kw, at a cost of about $250,000.

MEDICINE HAT, ALTA.—The city of Medicine Hat is considering the question of improving the street-lighting system and would like to receive catalogs from reliable firms giving detailed information and full description of their street-lighting outfits and general data in connection with the distribution of lamps and the cost of installation. A. K. Grimmer is city engineer.

PORT MOODY, B. C.—The British Columbia El. Ry. Co. will install 30 100-watt tungsten lamps for street-lighting purposes under a 10-year contract recently awarded the company.

SOUTH VANCOUVER, B. C.—The report of L. F. Rawdon, municipal electrician, in regard to the establishment of a municipal electric light and power plant has been adopted by the City Council. The proposition of issuing bonds for the construction of the proposed plant will be submitted to the taxpayers at an early election.

SYDNEY, B. C.—Negotiations have been closed between the City Board of Trade and the British Columbia El. Ry. Co., of Vancouver, whereby the company agrees to install electric lamps on the principal streets of the town immediately.

ASSINIBOIA, MAN.—The application of the city of Winnipeg to furnish energy for lamps and motors in the municipality of Assiniboia has been granted.

ROSSER, MAN.—The Winnipeg El. Ry. Co. has been granted a franchise to furnish energy for lamps and motors in Rosser for a period of 30 years.

BATHURST, N. B.—The Bathurst El. & Wtr. Co. expects to purchase this month four motors, one 12-hp, one 20-hp, one 30-hp and one 50-hp, with meters and transformers; also 20 new lightning arresters. The company has erected 6 miles of 6600-2200-220-110-volt transmission line. J. P. Leger is manager.

TRURO, N. S.—We are informed that most of the material has been purchased for the municipal electric-light plant being installed in Truro. G. C. McDowell, town engineer, has charge of the work. H. McDougall is town clerk and treasurer.

DUNDAS, ONT.—The town has taken over the street-lighting system and will make a number of improvements and additions.

L'ORIGNAL, ONT.—K. Marston, proprietor of the local electric-light plant, expects to purchase within the next 30 days one 5-kw pole transformer, 10 poles, one arc-lamp and bracket and four street-lamp fixtures for incandescent lamps.

NIAGARA FALLS, ONT.—Application has been made to the Queen Victoria Niagara Falls Park Commission by the Ontario Pwr. Co. to build a pipe line through the park. Preparations are being made by the company to build a third pipe line from its gate house above the falls on the Canadian side of the river to the power house just below the "Horseshoe" Falls, a distance of about 1¼ miles. The proposed line will be 18 ft. in diameter and will cost about $1,000,000.

ST. MARYS, ONT.—The electric light commissioners expect to purchase within the next six or nine months wire, transformers, graphic meter for customer taking about 400 hp, one 250-hp motor and 150 hp in four motors; also wire brackets and hoods for 25 100-cp series tungsten lamps. H. M. Miller is superintendent.

TORONTO, ONT.—The wires of the Toronto Hydro-Electric system will be placed underground on Melinda Street from Bay to Yonge Street and on Victoria Street from Queen Street to lane north of Loew's Theater, where the transformer pit will be located. The Toronto El. Lt. Co. will place its wires underground on Shaw Street, north of Dupont Street, under the Canadian Pacific Railway tracks, and at the intersection of Yonge and Temperance Streets.

TORONTO, ONT.—The Hydro-Electric Power Commission of Ontario has deposited with the Department of Public Works for Canada plans for a high-tension transmission line to be erected across the St. Lawrence River at Morrisburg. The Hydro-Electric Power Commission has secured an option of 15,000 hp from the New York & Ontario Pwr. Co., Waddington, and as soon as the plant is ready a portion of this power will be imported into Canada.

MONTREAL, QUE.—The Montreal Wtr. & Pwr. Co. is building a second transformer house (20 ft. by 40 ft.) at its plant in Point St. Charles. The company is supplied with energy by the Montreal Lt., Ht. & Pwr. Co. at 2200 volts, the latter furnishing three transformers of 1000 kva each. It is proposed to erect a duplicate line and also to duplicate the transformers and other equipment, the water company building the transformer house.

ESTEVAN, SASK.—By-laws appropriating $36,000 for the installation of a street-lighting system and for extensions to the power plant have been passed by the City Council.

REGINA, SASK.—The city of Regina expects to erect within the next three months a new power house and to install 8000-hp boilers and engines with a rating of 12,000 hp. Within the next two months the city expects to purchase coal and ash-handling machinery, and within the next six months yearly supply of transformers, poles, lightning-arresters, insulators, wire, cable and meters; also 500 arc-lamps, either alternating-current or direct-current, not yet decided.

Miscellaneous

PEARL HARBOR, H. I.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until Nov. 8 for furnishing one 100-kw motor-generator set and switchboard accessories at the naval station, Pearl Harbor, Hawaii. Specifications can be obtained upon application to the bureau. H. R. Stanford is chief of bureau.

New Incorporations

GERMANTOWN, NEB.—The Germantown Lt. & Pwr. Co. has been incorporated with a capital stock of $2,000 by F. W. A. Roehrkasse, M. B. Palmer and others.

HARRISBURG, PA.—Charters have been granted by the State Department for eight new electric companies, seven to operate in Schuylkill County and one in Northampton County, to interests allied with the Lehigh Valley Transit Co. Those issued in Schuylkill County were granted to W. B. Rockwell, Ira G. Walborn and Van Dusen Rickert, of Pottsville, for the Eastern Pennsylvania Lt., Ht. & Pwr. Co. to operate plants in Ryon, Centralia, Girardville, Butler, Gilberton, Conyngham and West Mahanoy Townships. Each company is capitalized at $5,000. The charter of the Edison Illuminating Co. of Easton was issued to H. R. Fehr, president of the Lehigh Valley Tran. Co., H. J. Steele and S. H. Hackett, of Easton; W. H. Walters, of Phillipsburg, N. J.; J. C. Dawson, Thomas Newhall, W. A. Sterne and A. L. Smith, of Philadelphia. The company will be capitalized at $350,000 and will operate in Northampton County.

READING, PA.—Charters have been granted by the State Department to J. H. Bucher, G. L. Roller and Harry H. Riegel, of Reading, for five electric companies to operate in parts of Berks and Lebanon Counties, to be known as the Jackson El. Lt., the Newmanstown, the Prescott, the Quittapahilla and the Schaefferstoen El. Co. Each company is capitalized at $5,000 and the offices will be located in Reading.

The companies were formed for the purpose of securing the right for the erection of a new transmission line from the large power plant of the Metropolitan El. Co. in West Reading to Lebanon and also to furnish electrical energy for lamps and motors in the towns for which the different companies are named. The proposed line will be erected on steel towers over a private right of way, 28 miles long, and will be a duplicate line. The cost of the work is estimated at about $125,000. C. C. Long, electrical engineer for the Metropolitan company, will have charge of the work; W. S. Barstow & Co., of New York, will do the construction work.

PIERRE, S. D.—The Niobrara Wtr. Pwr. & Ry. Co. has been incorporated with a capital stock of $16,500 by Charles W. Baker, of Omaha, Neb.; O. S. Christian, Madison, Neb.; Peter Mangold, Bennington, Neb.; Herman P. Bruhman, Leigh, Neb., and Glen W. Martens, Pierre. The company proposes to develop power from the Niobrara River and to construct and operate a railway in Yankton County, South Dakota, and in the counties of Holt, Knox, Cedar, Dixon, Thurston, Burt, Cuming, Stanton, Antelope, Pierce, Madison, Colfax, Dodge, Washington and Douglas, in Nebraska.

MEMPHIS, TENN.—The Interstate Ltg. Co. has been incorporated with a capital stock of $20,000 by W. S. Parks, C. F. Sinkle, C. A. Ferguson, J. W. Jones and F. J. Jachs.

WAUZEKA, WIS.—The Wauzeka El. Lt. & Pwr. Co. has been incorporated with a capital stock of $3,000 by Frank Kedl, James Tesar and James Willard.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED SEPT. 30, 1913.

[Prepared by Robert Starr Allyn, 16 Exchange Place, New York.]

1,074,179. VAPOR ELECTRIC APPARATUS; A. M. Jackson, Schenectady, N. Y. App. filed Apr. 8, 1904. The tubular mercury container is rotated on its axis by an electromagnet to start the lamp.

1,074,599. ELECTRIC SYSTEM FOR OPERATING SPEED VARYING POWER TRANSMISSION; R. W. Bradley, Fort Collins, Col App. filed Jan. 28, 1913. Shiftable element of the automobile transmission is automatically adjusted in accordance with the load or resistance encountered.

1,074,602. OVERLOAD DEVICE; H. R. Canfield, Cleveland, Ohio. App. filed March 22, 1911. Adjustable overload device which for equal increments of adjustment gives substantially equal increases in the amount of current at which the device operates or trips the circuit breaker.

1,074,654. THERMOSTATIC HEAT OR FIRE ALARM; G. S. Simpson, Morgantown, W. Va. App. filed May 23, 1912. Push button operated by expansible members.

1,074,672. METALLOIDAL MATERIAL; E. Weintraub, Lynn, Mass. App. filed Oct. 27, 1909. Electrically conductive and fusible material produced by interaction of boric chlorid and hydrogen at high temperatures.

1,074,677. ENUMERATION OF TELEPHONE CALLS; S. D. Williams, Newport, Wales. App. filed Oct. 31, 1908. On making a call the subscriber's enumerator and an enumerator in the subscriber's circuit at the exchange are simultaneously operated.

1,074,713. MAIL-BOX; U. C. Greggs and E. H. Falls, Terra Haute, Ind. App. filed Jan. 10, 1913. Push button on mail box sounds alarm in the house to give notice of placing mail in the box.

1,074,773. ELECTRIC REGULATOR; W. H. Clarke and O. A. Ross, New York, N. Y., and Chicago, Ill. App. filed Feb. 6, 1902. Particularly for headlights of electric cars; solenoid controls adjustable resistance.

1,074,782. SILVER CLEANER; J. L. Ennis, Reading, Pa. App. filed Feb. 25, 1913. Flat sheet with up-bent edges and a plurality of supports for the silver, slidably engaging the up-bent edges.

1,074,806. INCLOSED ELECTRIC FUSE; W. J. Morgan, St. Louis, Mo. App. filed Aug. 5, 1912. A removable closure in one side of the fuse casing permits access for the purpose of renewing the fuse.

1,074,807. ELECTRICAL SUSPENSION-RAILWAY; H. Müller, Leipzig, Germany. App. filed Feb. 7, 1906. The conductor line and two auxiliary lines are divided into blocks.

1,074,831. TELEGRAPH-KEY; R. L. Boulter, Los Angeles, Cal. App. filed Aug. 13, 1912. Of the vibratory reed or pendulum type, adjustable to slow or fast work, single dot produced as in the ordinary Morse key and plurality of dots are produced automatically without possibility of sending "split" dots.

1,074,841. ELECTRIC LOCOMOTIVE; J. Le C. Davis, Pittsburgh, Pa. App. filed Feb. 21, 1911. Frames of the driving motors constitute the entire frame of the locomotive.

1,074,859. ELECTRIC SIGNAL FOR RAILWAYS; J. H. Gunn, Cortland, N. Y. App. filed Aug. 3, 1908. Automatic open-switch signal.

1,074,860. ELECTRIC REVERSING-SWITCH AND CIRCUIT-CLOSER; C. Haas, Strassburg, Germany. App. filed Sept. 19, 1912. Switch members on a rock shaft, dip into mercury cups.

1,074,874. CONTROL SYSTEM FOR ELECTRIC MOTORS; J. H. Klinck, Pittsburgh, Pa. App. filed Jan. 26, 1910. Particularly for driving printing presses; a low-speed and a high-speed motor with means for controlling them jointly and severally.

1,074,878. ELECTRIC CURRENT CONTROLLER; H. W. Leonard, Bronxville, N. Y. App. filed March 24, 1906. For motors, etc.; controlling action is dependent upon and conforms to the condition of the motor.

1,074,882. REVERSING MECHANISM FOR ROLL-RAMMING APPARATUS; H. P. Macdonald, Montclair, N. J. App. filed Jan. 22, 1912. Reduces shocks and strains and limits the movement of the ramming roll positively.

1,074,911. CIRCUIT-CHANGER; E. Unverricht, Hamburg, Germany. App. filed May 23, 1911. System of interconnected electromagnetic circuit-changers.

1,074,925. CONTROLLER FOR ELECTRIC MOTORS; R. F. Baerlocher, Manchester, Eng. App. filed Feb. 3, 1910. Operating mechanism is automatically returned to predetermined position in case handle is released during a certain portion of its travel and in another part of its travel the handle may be left at any desired step.

1,074,928. ELECTRIC HEATING ELEMENT; T. M. Caven, Milwaukee, Wis. App. filed Aug. 1, 1911. Coiled resistance element embedded in plastic insulation disposed in plate of refractory material, with a metallic surface plate in cohesive relation with the plate and insulation.

1,074,961. MOTOR-CONTROLLING MEANS; H. W. Leonard, Bronxville, N. Y. App. filed July 22, 1907. Push button control.

1,074,962. AUTOMATIC CIRCUIT-CONTROLLING SYSTEM FOR ELECTRIC ELEVATORS AND THE LIKE; N. O. Lindstrom, Nutley, N. J. App. filed Oct. 18, 1911. Automatically varies circuit connections in accordance with direction of travel, load and speed of travel of elevator car.

1,074,988. APPARATUS FOR ELECTROLYSIS OF FUSED ALKALI CHLORIDS; E. Steinbuch, Monthey, Switzerland. App. filed Aug. 23, 1910. Obtains molten alkali metal and chlorin by electrolysis of a molten mass containing alkali chlorid.

1,074,999. METHOD AND APPARATUS FOR MAGNETIC SEPARATION; O. A. Zander, Stockholm, Sweden. App. filed Feb. 9, 1911. Ore is fed to a series of overlapping supports and a field of magnetic force is traveled in a direction transverse to the supports and substantially parallel with the direction of feed of the ore.

1,075,002. SURGICAL INSTRUMENT; J. Bandieri, Cincinnati, Ohio. App. filed Jan. 11, 1912. Syringe in which the liquid employed is electrically sterilized at the point of use.

1,075,007. TELEPHONE SYSTEM; J. G. Blessing, Chicago, Ill. App. filed Oct. 21, 1911. Combined quick and slow acting line relay for use in the selector and connector switches of automatic or semi-automatic systems.

1,075,026. PROCESS OF ELECTROLYSIS; H. M. Du Bois, Detroit, Mich. App. filed April 11, 1910. Flows the liquid across the electrolytic field within a space between the diaphragm and cathode.

1,075,032. TROLLEY WIRE CROSSING, SWITCH, AND THE LIKE; S. S. Goldman, St. Louis, Mo. App. filed April 24, 1912. Intersecting trolley tracks V-shaped in cross-section.

1,075,079. COUPLING FOR CABLE SECTIONS; S. A. Armstrong and P. T. Aumend, Niles and Warren, Ohio. App. filed Aug. 14, 1912. Includes annular members fastened to the cable ends and connected by an enclosing barrel or sleeve.

1,075,093. CYCLIC PROCESS OF EXTRACTING METALS FROM CUPRIFEROUS MATERIALS; A. David, Brooklyn, N. Y. App. filed July 9, 1913. Leaches the material with a solution containing a ferric salt, precipitates the dissolved copper by electrolytic iron and electrolyzes the spent solution under conditions to precipitate iron in highly reactive form.

1,075,098. CIGAR LIGHTER AND CUTTER; A. Gray, New York, N. Y. App. filed April 26, 1912. As lamp is shifted forward, contact is made to ignite wick.

1,075,209. WELDING MACHINE; J. H. Gravell, Philadelphia, Pa. App. filed Jan. 17, 1913. One of the welding terminals is bent back upon itself so as to handle various-shaped articles without increasing the length of the secondary circuit.

1,075,217. HIGH VOLTAGE INSULATOR; M. P. Maxwell, Brooklyn, N. Y. App. filed July 12, 1911. Insulator units provided with hooks by which they may be linked together, together with gravity-operating pins closing the open sides of the hooks.

1,075,238. ELECTRICAL SWITCH; O. N. Wiswell, Snoqualmie, Wash. App. filed July 12, 1911. Compound spring jaws adapted to receive a switch blade between them.

1,075,257. TELEPHONY; M. L. Johnson, Chicago, Ill. App. filed Aug. 10, 1911. A party line taken for use, is guarded against the intrusion of the other stations upon the same line.

1,075,258. TELEPHONY; M. L. Johnson, Chicago, Ill. App. filed Dec. 4, 1912. Calling subscribers may signal an operator, whose function it is to pass upon the propriety of permitting such calling subscriber to have free connection.

1,075,259. TELEPHONY; M. L. Johnson, Chicago, Ill. App. filed Aug. 10, 1911. Telephone exchange system in which some of the lines are party lines and in which common batteries are employed at the exchanges.

1,075,260. TELEPHONY; M. L. Johnson, Chicago, Ill. App. filed Aug. 10, 1911. Communication between party line stations to the exclusion of the exchange.

1,075,270. ELEVATOR SIGNALING APPARATUS; T. Porter, New York, N. Y. App. filed April 17, 1913. Automatic switch causes the signal at the floor to remain on until a car actually stops at the floor.

1,075,292. COLLECTOR-RING FOR DYNAMO-ELECTRIC MACHINES; A. Kingsbury, Pittsburgh, Pa. App. filed July 28, 1909. Metal body ring and a pair of segmental contact rings seated thereon.

1,075,295. ELECTROMETALLURGICAL PROCESS OF REDUCING METALLIC OXIDS; D. A. Lyon, Palo Alto, and E. R. Cox, Jr., Heroult, Cal. App. filed April 13, 1909. Reduces a metallic oxid by subjecting the same to the combined action of carbon and an electric current.

1,075,314. ELECTRIC FIRE-ALARM SYSTEM; J. L. Flagg, Hackensack, and F. T. Towers, Hawthorne, N. J. App. filed June 7, 1913. Normally open alarm circuit is automatically connected to one or the other of two sources of energy upon the interruption of a closed signal circuit.

1,075,315. AUTOMATIC TRANSMITTER FOR TELEGRAPHIC SYSTEMS; J. Gell, London, Eng. App. filed Jan. 24, 1911. Special key action.

1,075,318. LAMP SOCKET; T. R. Willwerscheid, St. Paul, Minn. App. filed Sept. 27, 1911. For housings or outdoor signs.

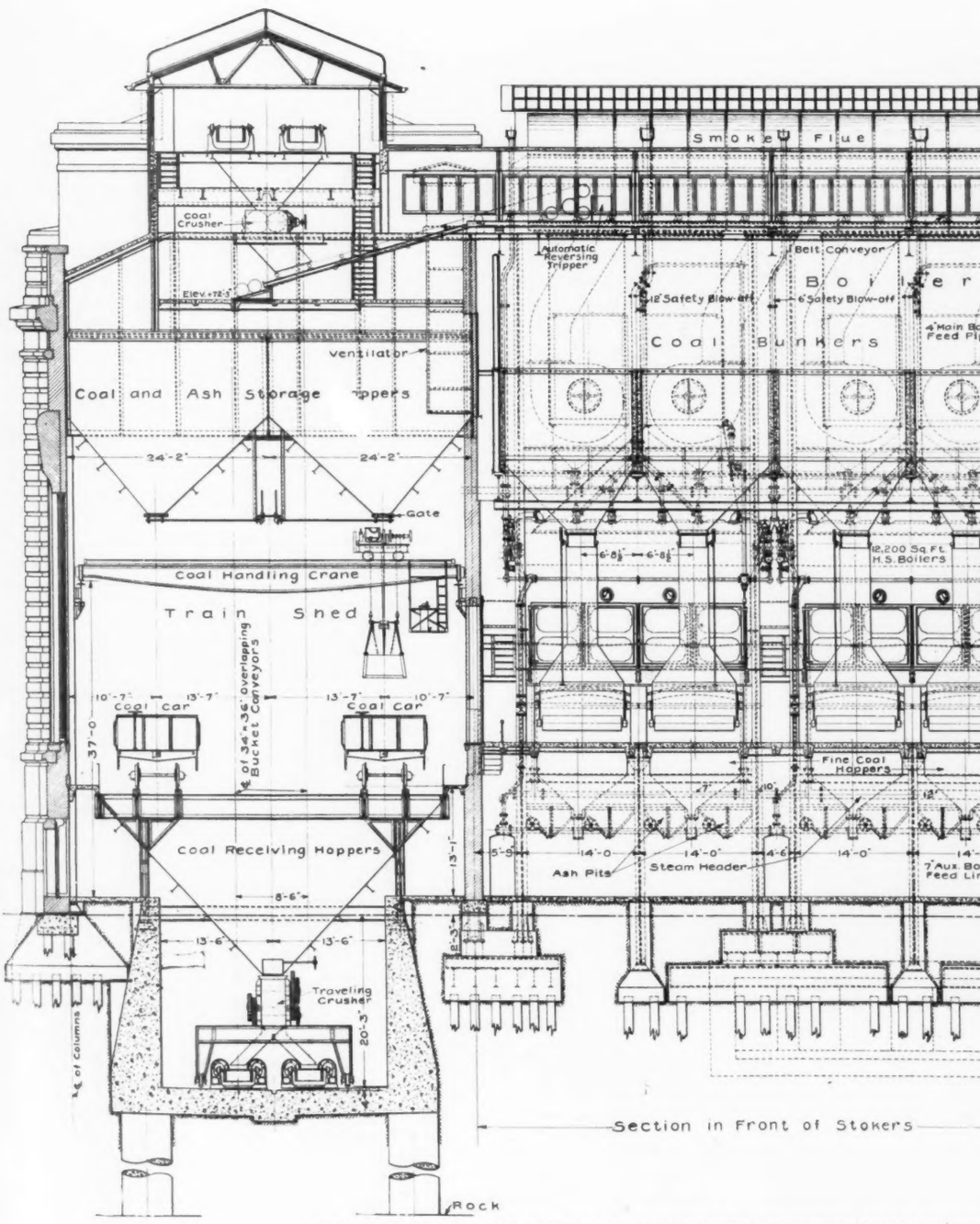
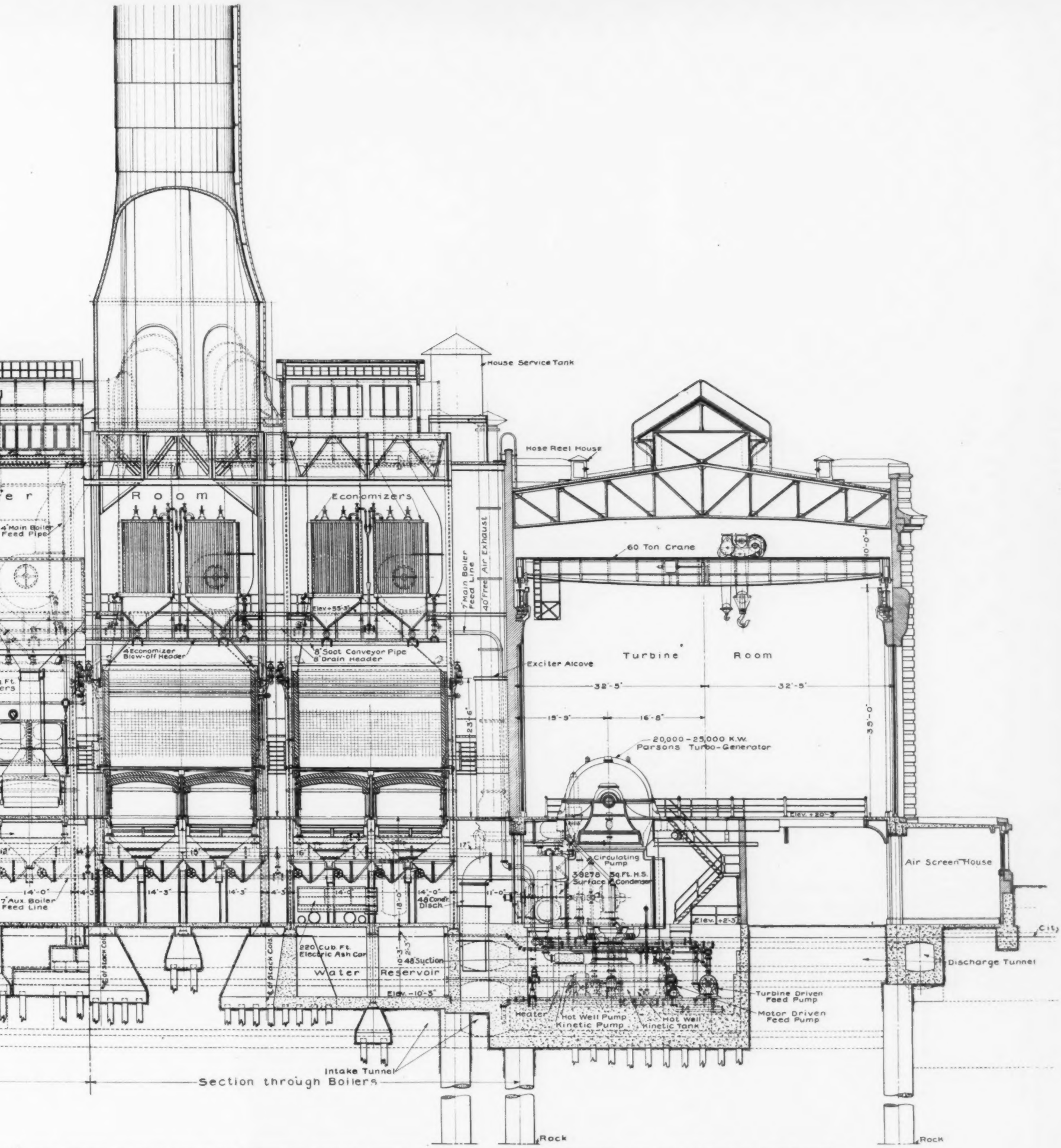


FIG. 3—GENERAL CROSS-SECTION OF COMMONWEALTH EDISON COMPANY'S F



NY'S FISK STREET STATION EXTENSION, SHOWING ENGLISH TURBO-GENERATOR, BOILER, ECONOMIZER AND COAL-HANDLING EQUIPMENT